

APR 6 - 1935

American scientist, the

SIGMA XI QUARTERLY

VOL. 23

MARCH, 1935

No. 1

SEMI-CENTENNIAL, ITHACA, JUNE, 1936



CONVENTION PROCEEDINGS

HOOTON ON MAN'S ORIGIN AND FUTURE

KIMBALL ON OLD FEATURES OF THE NEW DEAL

GARTH ON COLOR BLINDNESS

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Published at Burlington, Vermont, by the Society of Sigma Xi

ANNUAL SUBSCRIPTION \$1.00 SINGLE COPY 25 CENTS

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Entered as second-class matter at the Burlington, Vermont, post office under the Act of March 3, 1879. The SIGMA XI QUARTERLY is published at 187 College St., Burlington, Vt., in March, June, September and December.

Change of address of chapter members and associates should be communicated to chapter secretaries and to the National Secretary.

Subscriptions should be sent to the National Secretary, Edward Ellery, 187 College St., Burlington, Vt., or Union College, Schenectady, N. Y.

Manuscripts should be sent to the National Secretary at Schenectady, N. Y.

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SIGMA XI QUARTERLY

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No. 1

THE SEMI-CENTENNIAL

For the next year and a half the thoughts of all Sigma Xi members and associates should be directed to the celebration of the fiftieth anniversary of the birth of our great society. This important event is to be appropriately observed at Cornell University, where the society was founded in 1886. The dates set are June 19 and 20, 1936. The program will supplement that arranged for the summer meeting of the American Association for the Advancement of Science which is scheduled to be held in Rochester. Cornell University and the Cornell Chapter are cooperating generously and enthusiastically with the semi-centennial central committee and committee-at-large in making preparations for the event. Sigma Xi members and associates from all over the world are showing deep interest in the program. Sigma Xi is the only scientific organization of its size in the world, with the definite object of promoting research, which meets its purpose by a suitable recognition of the promise of research ability given by young men and women in their undergraduate years and of noteworthy achievement in research by more mature and more experienced scientists.

The first report of the Semi-centennial Central Committee is printed in full in this issue of the Quarterly. Subscribers are asked to read it, and to offer comments and suggestions to the Committee through the National Secretary.

REPORT OF CENTRAL COMMITTEE ON SEMI-CENTENNIAL PROGRAM

Following is a composite of suggestions for the observance of the Semi-Centennial made by the members of the central committee, Professor Parker, Professor Pegram, Dr. Whitney, Mr. Davies, Dean Richtmyer, Secretary Ellery.

1. SEMI-CENTENNIAL RECORD AND HISTORY.

It is agreed that a Record and History should be published uniform with the Quarter Century Record and History issued in 1911; that the book should contain a history of the Society, chapter histories, and list and record of members and associates; that there should be chapter, alphabetical and geographical lists of members and associates; and that in addition members and associates should be listed according to their field of work and their scientific or other hobby.

2 THE PROGRAM OF THE SEMI-CENTENNIAL CELEBRATION IN ITHACA, JUNE, 1936.

It is agreed that there be three sessions, an afternoon and evening session on one day and a morning session on the following day.

Program of the afternoon session, Friday, June 19:

- a. Greetings from the President of Cornell University.
- b. Response from the President of Sigma Xi.
- c. A brief history of Sigma Xi.
- d. Greetings from the universities and colleges where Sigma Xi is installed to be given by a representative of the educational institutions, emphasizing the sort of service Sigma Xi can render the universities and colleges in the years to come.

Program of the evening session, Friday, June 19:

- a. The Cornell Chapter invites delegates and guests to a complimentary dinner.
- b. It is proposed that the dinner be followed by an address on the relation of science to social development, analyzing the situation as it is today, and if there is something wrong in the adjustment, trying to find whether the fault is with science or with the social organism, and pointing the way out to be followed in the immediate future.

Program of the morning session, Saturday, June 20:

Two addresses:

- a. Accomplishments and the future of the physical and earth sciences, with emphasis on applied science.
- b. Accomplishments and the future of the biological sciences, with emphasis on pure science.

3. THE SEMI-CENTENNIAL AWARD FOR RESEARCH.

It is agreed that the award should be made for research in progress and

in support of such work; that the award be given to a young research worker of promise—by young meaning under forty years of age; that for the semi-centennial year there be two awards of \$1,000 each, one for a worker in the fields of the physical and earth sciences, and one for a worker in the fields of the biological sciences; that chapters nominate candidates before March, 1936; that a committee of award be appointed to make decision.

4. CITATIONS FOR MERITORIOUS RESEARCH WORK.

It is agreed that citations be made for meritorious research work accomplished; that one individual from each of the nine scientific fields which Sigma Xi represents be selected for citation; that chapters be asked to nominate candidates for citation, limiting nominees to scientists of the United States and Canada, but that candidates not be limited to the locality of the chapter making the nomination; that the citations be engrossed on parchment.

It is suggested that chapters of Sigma Xi be cited at the Semi-Centennial for specific achievement in furthering the object of the Society, the promotion of research.

5. A COMMEMORATIVE TABLET.

It is agreed that a bronze tablet suitably inscribed be erected at Cornell in the room where Sigma Xi was founded, commemorating the founding of the Society and its Semi-Centennial.

6. ACCOMMODATIONS FOR DELEGATES AND GUESTS.

It will be possible for delegates and guests to find accommodations for one or two nights in the dormitories of the University at moderate rates. It is thought possible also to arrange for meals on the campus, other than the complimentary dinner proffered by the Cornell Chapter.

GEORGE HOWARD PARKER, *Chairman*

EDWARD ELLERY, *Secretary*

GEORGE B. PEGRAM, *Treasurer*

WILLIS RODNEY WHITNEY

C. E. DAVIES

FLOYD K. RICHTMEYER

HOMO SAPIENS—WHENCE AND WHITHER*

ERNEST A. HOOTON
Harvard University

INTRODUCTION

The male human creature in our Society is supposed to have "come of age" when he has completed his twenty-first year. An alleged scientist ought to have attained his majority when he has passed the twenty-first anniversary of his professional career. Unfortunately he may remain forever a minor, even if he has reached the "age of discretion." Nevertheless, I propose to survey the increments to our knowledge of that animal, man, during the past score and odd of years, whether my utterances be the brash pipings of the callow juvenile, the resounding platitudes of waisty middle age, or the reminiscent quaverings of senility. In any event, I firmly absolve myself from responsibility for the anthropological accretions of which I here take note, since any pebble which I in passing may casually have dropped upon the rock pile has simply disappeared in the chinks between the ponderous contributions of my more substantial colleagues. In short, like the famous young man on the hearse, I have just come for the ride.

NEW VIEWS OF PREHUMAN PROBLEMS

One may well begin with some new angles from which recent observers have viewed prehuman problems. These are zoological angles rather than mathematical angles. Nevertheless, some of them are acute and others are obtuse. The first problem which may be viewed thus askance is that of the origin of the primates. (I refer to the zoological order rather than to the ecclesiastical order.) The research of the last two decades has aroused suspicion that the primates had an origin which was at once lowly and lofty—lowly because they appeared to have sprung from primitive and timorous insectivores, lofty because these insectivores in some previous incarnation had been chased up a tree. There they remained, supposedly, cutting down their litters and their claws, sacrificing philoprogenitiveness for security, and efficiency in scratching for facility in gripping with opposable thumbs and great toes. In the fullness of time and species gestation, some ambiguous and generalized insectivore was suspected to have given birth to a primate. And believe it or not, this adventure in obstetrics was accomplished by an animal whose static collateral descendant is called a tree shrew (a designation which seems to have been a sort of *ex post facto* prophecy of the articulate gift of that ultimate primate, woman).

However, this simple view has been challenged by the recent ruminations of comparative anatomists. Thus W. Le Gros Clark has lately reached the conclusion that the tree shrews must be recognized not as progenitors of the primates, but rather as early secessionists from a primitive primate stock

* The thirteenth annual Sigma Xi lecture, Pittsburgh, Pa., December 28, 1934.

which had already spawned protolemuroids.¹ Thereby a mother is degraded to a niece. Some of you may have swallowed our alleged affinity with the anthropoid apes without even a gulp, may have choked down our putative relationship to the regrettably obscene monkey, but may have gagged over the glassy-eyed, frozen-faced lemur, which suggests the product of some unhallowed alliance between a degenerate fox and a libertine marmoset. For these, if such there be, I have a word of cheer. Le Gros Clark and other meticulous primatologists have summarily banished from the assemblage of our ancestors the lemur, the loris, and all of their ilk. This means that it is no longer "legitimate" to speak of a "lemuroid" phase in the evolutionary history of the Anthropeidea, which include monkeys, apes, and man. You may well inquire whose tree it is upon which our simian forbears have perched. The answer is "Tarsius spectrum." Who then is this Tarsius who comes knocking for admission to the genealogical order of Daughters of the Human Evolution? The contemporary animal is the size of a small rat, with a furry body terminated by a long tail bare in the middle and hairy at both ends. It has monstrous eyes, seemingly directed forward, very large ears, and a pinched and retracted snout. Its ankle bones are enormously elongated (whence the name Tarsius). It hops on its hind legs like a miniature kangaroo. The five digits of its hands and feet are provided with sucker discs; the thumb and the great toe are opposable to the other digits; the second and third toes are clawed. Tarsius is arboreal and nocturnal; it produces one young at a birth and feeds itself with its hands. This otherwise somewhat eccentric animal, found today only in the Indo-Malayan Archipelago, has become the storm center of a zoological controversy. It displays a certain number of features suggestive of a real affinity with the higher primates—among them the absence of a moist muzzle, the conformation of the external genitalia, the form of the incisor and premolar teeth, the type of the placenta, the tubular shape of the auditory meatus, *et cetera*. In some other features it is related to the lemurs or merely "apes the apes."² Particularly because Tarsius sits erect, feeds itself with its hands, has a short snout, frontally directed eyes, and a brain in some respects well-developed, ingenious anatomists have made it the hero of a sort of scientific Just So story of primate evolution. Thus hopping and squatting on the hind limbs encourages an upright body poise and "emancipates" the fore limbs. These pentadactyle extremities, clawless and with opposable thumbs, may now be used for all the varieties of mischief which Satan has for idle hands to do. They can investigate the animal's whole corporeal entity and adjacent objects of the external world. They can be used to lift things toward the eyes for visual examination, toward the nose for olfaction, and toward the mouth for tasting, chewing and swallowing. In short, these emancipated hands become not only mere conveyors of nourishment, but instruments of research and investigation and the potential creators of tools and all of the appurtenances of material culture. However, the mere prehensile function of the hands

¹ Clark, W. E., *Le Gros, Early Forerunners of Man*, London, 1934, p. 250.

² Clark, *Le Gros, op. cit.*, p. 265.

is of small import in comparison with the secondary effects of this new usage upon other organs. The exploratory digits relieve the snout of its tactile function; the feeding fingers absolve the jaws from grazing duties; the protrusive muzzle recedes, and the laterally directed eyes (apparently in a strabismic effort to ascertain the fate of the vanishing snout) swivel round to the front so that the fields of vision converge. The animal can now look down its nose to examine with stereoscopic clarity and depth the object presented by its prehensile hands. The recession of the overbalancing jaws gives poise to the head and facilitates rotary movements, so that parts of the body previously invisible are presented to the sight, as well as being accessible for palpation. Sound waves are now caught by turning the head instead of cocking the ears; the latter curl up. As the jaws shrink, the temporal muscles relax their constricting grip upon the skull vault, and reluctantly retreat down the parietals. This of course gives the brain its chance. But the modest yet ambitious neopallium has other incentives for expansion. The investigative digits seek and acquire in the brain cortex not only motor representation but also adjacent areas of pictured movements; now the animal cannot only see what it is doing but can also recall to the mind's eye past actions and can even build castles in the air. Naturally association areas then spread like a rash; the neopallium becomes furrowed with thought; the brow bulges with cerebration. All of this we owe to *Tarsius*—a humble primate Prometheus. If you are a functionalist, you may thumb your nose at the spectre of Weismann, and accept as your ancestor this spectral tarsier thumbing its way along the ascending road of evolution—hopping toward humanity. A slight difficulty may indeed obtrude itself when one considers certain specializations of this, our ratlike ancestrix. We ought with such a pedigree to have the gait and pedal extremities of a kangaroo, and eyes like teacups, millstones, or towers—such as those possessed by the three marvelous dogs in Hans Anderson's story, "The Tinderbox." For it appears that even the earliest fossil tarsiods exhibit evidence of enlarged orbits and elongated ankles. Here, forsooth, we find ourselves impaled upon the horns of a dilemma: either we are descended from a tarsiod which had not yet become specialized for hopping and had refrained from orbital exaggeration, or else our tarsiod or subsequent ancestors have violated the law of the irreversibility of evolution. In the former case we are indeed lost, because if there was no hopping there could have been no handling, no hand feeding, no cortical representation, no Anthroipoidea, no *Homo sapiens*. In the latter case we dare not face the palaeontologists.

As a matter of fact, it is comparatively simple to evade both of these difficulties. In the first place we need not accept literally the Lamarckian lucubrations of Professors Elliot Smith and Wood Jones, whereby *Tarsius* in merely sitting up initiates a perpetual motion of motor cause and cortical effect which inevitably leads onward to humanity. The only existing primate of certain tarsiod ancestry is the diminutive goggle-eyed beast of Borneo, which is apparently no farther away from man than the most of the twenty fossil species of Eocene tarsiods. The dog-faced baboon is not only an invet-

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erate hand-feeder but also a confirmed quadruped, which has either redeveloped a prodigious snout in utter defiance of the law of irreversibility or, having preserved and enlarged a primitive primate snout, has nevertheless managed to rotate his eyes around to a frontal plane and to achieve stereoscopic vision, with a complete disregard of the views of Prof. Frederic Wood Jones.

The so-called law of the irreversibility of evolution is easy to circumvent by a sophistry which enables the palaeontologist or zoologist to include in man's ancestral line the fossil precursors of almost any primate, however specialized its modern descendants. Thus in the case of tarsoids it is merely necessary to state that man's ancestors have sprung from a generalized proto-tarsoid stock which had not yet developed the evolutionary specializations, which would rule the modern tarsier and most fossil tarsoids out of the human line of descent. In this way the zoological genealogist manages both to eat his cake and to have it.

Another convenient device much used in evolutionary dialectics is known as the "law of convergent or parallel evolution." This law affirms that similar or identical variations may be developed independently in unrelated forms "which happen to be subjected to similar environmental forces."³ Citation of this law enables the fabricator of family trees to dismiss as irrelevant and illusory all morphological similarities in those animals which he wishes to exclude from close relationship to man. Wielding the law of irreversibility of evolution in one hand, and that of convergent evolution in the other, the brain trusters of the zoological New Deal can excommunicate from the assemblage of man's ancestors any unfortunate stock of which the contemporary representatives seem undesirable poor relations. Conversely, by a skillful blending of motifs upon the same two instruments, the pied pipers of primatology lead off ratlike tarsiers and godlike men in one genealogical rout. Actually these alleged evolutionary laws are more honored in the breach than in the observance, even by those who most loudly invoke them. Hence the mere anthropologist remains unimpressed when Prof. Wood Jones in a single burst of zoological rhetoric reads out of man's party the tree shrews, the lemurs, all of the monkeys, and even the anthropoid apes. However, even the ardent advocates of parallelism and irreversibility are ill content to leave man out on the end of a limb with no company in his family tree except that of a nebulous, nocturnal tarsier.

Yet, apart from the heresy of Wood Jones, who has seceded in a body from orthodox opinion as to man's descent, other minor dissensions have arisen in the ranks—voiced at times by major dissentients. Thus we have to deal with the growing heresy which maintains that man is not descended from a giant brachiating ape, but from some small ground-walking anthropoid which had abandoned tree life and cut himself off from relationship with the arboreal ancestors of the great apes as far back as the Oligocene period. This infant Ishmael seems to owe his existence principally to an unhappy afterthought of Prof. Dudley J. Morton, added to his otherwise admirable memoir upon the

³ Clark, *Le Gros*, *op. cit.* p. 5.

evolution of the human foot.⁴ Morton observed that the mid-tarsal pattern of the gibbon resembles that of the monkeys, whereas in the great apes this region of the foot is decidedly shortened. Man appears with the more primitive pattern of a long mid-tarsal region. Morton therefore infers that man could have avoided this mid-tarsal shortening only by separating from the great ape stock before it occurred. He suggests that the shortening of the mid-tarsal region in the great apes has been the effect of the attainment of a great body bulk, the weight of which has crushed the mid-tarsal bones, and that man gained this great increase in size after he had adapted the use of his foot so that the crushing effect of body-weight would not be exerted upon the mid-tarsal area. Doctor Morton further concludes that "the retention of the more primitive mid-tarsal pattern supplies evidence of three phases in man's history; the early attainment of the erect posture, separation from the great ape stock before it had attained its modern large size and early adoption of terrestrial habits." This sweeping conclusion has been greeted with acclaim by the protagonists of the Homunculus theory, i.e. the diminutive dawn man. For my part, I see no reason why "Wolff's law" of atrophy and hypertrophy, which Doctor Morton frequently invokes, should turn a somersault by "crushing" the mid-tarsal region when the bodily weight is transmitted to it, although enlarging the heel-bone when the bodily weight rests upon the latter. If one insists upon crying "Wolff! Wolff!" when there probably is none, one may as easily ascribe the supposed shortening of great apes' mid-tarsal region to adaptation for greater mobility in grasping; or to atrophy as a result of these animals' brachiating habits, whereby they suspend the weight from the hands rather than resting it upon the feet.

On the whole it seems to me that it is most unsafe to attempt to determine degrees of phylogenetic relationship solely by the examination of resemblances and differences in such a highly adapted organ as the foot. The only safe bases for reckoning affinity are hereditary, non-adaptive variations of organs in which form is not closely dependent upon function. The foot and the pelvis in man are perhaps of all skeletal parts the most rigorously adapted to human bodily habits and to functional needs. By virtue of such stringent adaptation they are the least suitable structures from which to deduce phylogenetic conclusions. Zoological classification should never rest upon the evidence of any single anatomical character, however important, but always upon the cumulative testimony of as many non-adaptive hereditary features as can be marshalled for examination. Beware of special pleaders who would chart the course of primate evolution by the use of a compass whose needle points always to the same magnetic pole—whether it be the tarsus, the tympanic ring, the frontal sinus, the placenta, or the pattern of molar teeth! Gifted persons may conjure rabbits out of silk hats or Homo sapiens from a hopping tarsier, but though the hand may be quicker than the eye, no one need believe that the topper has conceived a bunny. It is with relief that one turns from the school of presti-digitative or saltatory evolutionists to the tortoisian plodders who escort our postulated progressive primate to the goal of humanity by a slower and less spectacular, but surer

⁴ Morton, Dudley J., *Evolution of the Human Foot*, *Am. J. Phys. Anthr.*, Vol. V, No. 4, pp. 305-336, 1922; Vol. VII, No. 1, pp. 1-52, 1924. Cf. especially p. 36.

route. As the heavyweight champion of the great ape theory of human descent, we may acclaim Dr. William King Gregory, who has suffered the bludgeonings of Wood Jones and the pro-tarsioids and has emerged with head not only unhowed, but not even perceptibly bloody. Doctor Gregory neglects no biological system which may furnish evidence apposite to the solution of the problem. He makes a clean sweep through the whole range of vertebrate evolution. Although he displays an astounding familiarity with all of the minutiae of vertebrate anatomy, Professor Gregory is perhaps most intimate with the development of the skull and the teeth. He is indeed such a consummate master of odontology that, were we to start anew with a planned, controlled, and supervised organic evolution, we should without doubt entrust to him the destiny of dentition, merely stipulating that he devise this time a less cumbersome and misleading terminology. In his most recent monograph entitled "A Half Century of Trituberculy" (which is not to be mistaken for the autobiography of a trebly afflicted unfortunate) Doctor Gregory convincingly describes eleven stages of molar tooth development leading from primitive fish to modern man, the ninth or anthropoid ape stage giving rise to a five-cusped lower molar with a so-called Dryopithecus pattern of cusps and grooves, which is preserved in the first molars of most primitive and many modern men. Gregory considers the evolution of the locomotor skeleton, the jaws and teeth, the face and the brain-case, carrying the story of each from the early vertebrate forms up to the human culmination, all themes of the various narratives leading to the conclusion that man developed in late Tertiary times from a giant, brachiating, arboreal ape of a generalized Dryopithecus type. Dryopithecus is the name of a family of anthropoid apes represented by numerous fossil jaws and teeth from the Miocene and Pliocene deposits in Europe, Africa, and Asia. Unfortunately the remains are usually restricted to jaws and teeth, because these are the most durable parts of the skeleton, being also especially tough and indigestible morsels. But a femur from the Lower Pliocene in Germany, referred to Dryopithecus, apparently represents the anthropoid thigh bone before it was affected by giantism, and is long and slender like that of a gibbon. Schlosser could discover in it nothing that would forbid its giving rise to the more specialized and shortened femora of the great apes, or to the hypertrophied thigh-bone of an upright bipedal man. Moreover the humerus supposed to belong to this same early anthropoid ape is shorter than the femur, contrary to the condition in the modern specialized great apes.

An important discovery of the past decade is that of the skull of a juvenile anthropoid ape at Taungs, Bechuanaland, South Africa. This specimen consists of most of the face and forehead and a cast of a portion of the brain. Professor Raymond Dart, the describer, gave it a place between the highest anthropoid apes and the lowest grades of humanity. Sir Arthur Keith has concluded that this fossil, *Australopithecus*, was an ape with a closer resemblance to the chimpanzee than to the gorilla, but a cousin form to both.⁵ Nevertheless in the volume of the brain, in the reduced size of the milk canine, and in the per-

⁵ Keith, Sir Arthur, *New Discoveries Relating to the Antiquity of Man*, N. Y., 1932, pp. 37-116.

sistence of certain infantile traits, Keith thinks that this ape approaches nearer to the human prototype than any form heretofore discovered.

More recent still is the preliminary notice of new anthropoid apes from India by the Yale North India Expedition.⁶ These finds include several new genera and species which, in the shape of the dental arch, the reduction of the canines, the absence of diastemata, or gaps, are said to approach so closely to the human type that they may well be near the stem which led to the Hominidae proper. Such finds raise high hopes that we may yet discover the remains of that miraculous evolutionary deviant among the apes, which eventually foisted upon the faunal world Huxley's erect and featherless biped.

Within the past year Dr. S. Zuckerman has published a fascinating work on the functional affinities of man and the other primates.⁷ He has assembled the evidence relating to differentiation of the mechanism of reproduction, blood reactions, visual and olfactory processes, behavior patterns, diseases and parasites, affinity and divergence as shown by hybridization, psychological measures of intelligence, implications of cortical physiology. Zuckerman concludes:

"Man's immediate phyletic relationship to the ancestors of the anthropoid group of Primates cannot be doubted, unless it be argued that he developed the same blood groups, the same serum proteins, and the same peculiarities in purine metabolism independently of the anthropoids."⁸

Nevertheless, after an impartial review of the physiological evidence, he feels that it is impossible, in our present state of knowledge, to determine whether man's divergence from the common anthropoid-humanoid stock took place in the Oligocene before the present great apes had differentiated, or at some subsequent period. For he points out that such physiological peculiarities as the blood groups, which man shares with the anthropoids, seem most probably to have developed independently in the different stocks, and are therefore due to convergent or parallel evolution and orthogenetic evolution within the confines of a natural subgroup.

In the past two decades experimental psychologists have become ape-conscious, and one of our great universities has been a pioneer in the recognition of the academic status of the chimpanzee. There has been accumulated a mass of experimental data tending to show that monkeys and apes differ from other mammals in that the former manifest a characteristic called "insight," which implies a complete solution of an experimental problem as a result of a general survey of the entire layout. This behavior with "insight" is contrasted with the "trial and error" method generally believed to be characteristic of lower animals. Gradually an edifice has been built up which seems to start with the inferior intelligence of rats in the basement and to progress upward story by story until it reaches the almost human faculties of the anthropoids on the roof, man with his supreme endowment hovering over all. Thus Yerkes and Yerkes in 1929 were able to conclude their colossal work upon the great apes with a formidable list of psychological contrasts between primate types:

⁶ Lewis, G. Edward, Preliminary Notice of New Man-like Apes from India, *Am. J. Sci.*, Vol. XXVII, March, 1934, pp. 161-179.

⁷ Zuckerman, S., *Functional Affinities of Man, Monkeys and Apes*, N. Y., 1933.

⁸ Zuckerman, S., *op. cit.*, p. 169.

"phylogenetic differences in behavioral expressions of curiosity, interest, attention, emotion, mood, sentiment; confidence in man and intelligent cooperation with him, rapidity and extent of adaptation to captivity; diversity and complexity of receptivity, sensibility, and perception, functional importance of contact senses, degree of value and dominance of hearing and vision; analysis and synthesis of mental objects; vocalization, approach to speech, intercommunication by visual and auditory signs and symbols; diversity of actions in problematic situations; frequency and importance of accidental (trial and error) adaptations; ability to perceive and react adaptively to relations (structure-function) *versus* familiar objects; insight, understanding, anticipation, expectation, disappointment, foresight; preadaptation; temporal span and complexity of memory; creative imagination, versatility, ingenuity, inventiveness, constructivity; adaptive modification of environment, modification of other organs by tuition or instruction, use of objects as instruments, construction or fashioning of implements.

"Some of these phenomena are observable in all primates, some in all except the Prosimiae, others only in ape and man, and a few in man alone. Usually vast gulfs separate the types, and with a few exceptions the indicated or definitely demonstrated trend of development and serviceability is from lemur to man."⁹*

Unfortunately even this grand and towering structure has been scarred recently by bullets of revolutionary and communistic snipers who will have none of this primate hierarchy. Thus Zuckerman points out that the term insight is no explanation of behavior, but simply an aid to description which leads nowhere if too much reliance is placed upon it.¹⁰ It is rather disconcerting to discover that behavior with insight, so far from being an exclusive prerogative of higher primates, is also characteristic of cats, dogs, and even of rats. It is even more discouraging to learn that an ordinary American monkey tested by Doctor Haan, seemed to be no less intelligent than the chimpanzee and much more so than the gorilla, orang, and gibbon. Various other investigators, whose work is summarized by Zuckerman, have apparently found that there is no exact positive correlation between zoological status within the primates and so-called measures of "intelligence."

On the whole, then, it would appear that the labors of palaeontologists, comparative anatomists, and psychologists have not yet led to any precise determination of man's relationship to individual genera and species of the primate order. No primate with a properly developed instinct of self-preservation, would be willing to entrust his weight to any of their zoological family trees.

For myself, a naïve physical anthropologist, the way still seems comparatively straight and plain. I adhere to the old-fashioned belief that the more numerous and detailed the resemblances between two animals the closer the

⁹ Yerkes, R.M., and Kerkes, A. L., *The Great Apes*, p. 578, New Haven, 1929.

* This quotation recalls Huckleberry Finn's comment upon Bunyan's "Pilgrim's Progress": "The statements was interesting, but tough."

¹⁰ Zuckerman, S., *op. cit.*

relationship between them. Effects of similarity or difference of habitus cannot obscure man's fundamental likeness to the great anthropoid apes, and especially to the gorilla and the chimpanzee. I therefore persist in the opinion that these two apes are our nearest collateral relatives, and as yet am aware of no convincing evidence which conflicts with the theory that the gibbon was an early deviant from a small and primitive generalized anthropoid ape stock; that the main line of anthropoid-humanoid development continued at least into the Miocene period, when giantism began to affect simultaneously the diversifying strains of these arboreal apes. Then it would appear that the ancestors of the orang-utan first began their course of evolutionary divergence, leading ultimately to a rigid specialization for slow brachiating. For some time thereafter it seems probable that the ancestors of man and the African apes pursued similar evolutionary courses, until accident or initiative (and I favor the latter explanation) led the proto-human stock to take its chance on the ground. This radical change of habitus must have taken place before our ancestors had undergone any of the excessive specializations consequent upon brachiation, which have involved the hypertrophy of the upper limbs and comparative atrophy of the lower limbs in contemporaneous great apes. But I see no reason for supposing that the descent to the ground occurred before the latter part of the Miocene period, when man had already stamped upon his molar crowns the indelible sign of his *Dryopithecus* heritage.

THE ENIGMA OF FOSSIL MAN

In the past two decades the specialists who deal with fossil man have been confronted with an ever increasing number of geologically ancient skeletal remains, each succeeding one apparently adding to an existing confusion. At the beginning of the century the tale of fossil man was brief and apparently fairly intelligible. A series of finds in Western Europe had revealed the bony remains and the stone implements of a race of men who inhabited caves during the last glacial advance. These Neanderthaloids were short, bull-necked, barrel-chested individuals, with many features of the bones of the trunk and of the extremities suggesting an affinity with the great apes less remote than that of modern man. The most striking features were, however, those of the skull. The long and narrow brain-cases were of moderate size or even large, but flattened down and low; their orbits were surmounted with huge bony brow-ridges, behind which the forehead retreated in an ignominious fashion. The jaws were protrusive to the verge of snoutiness; the chin receded practically to a vanishing point; the teeth were massive but without canine projection; the pulp cavities of the molars were enlarged, as in animals which chew the cud. These apish men seemed to fulfill the requirements of an early ancestral human type which had not yet sloughed off many of its anthropoid attributes. They were succeeded in the upper strata of the European caves, representing the last glacial retreat, by several morphologically modern types of man. In 1907 a sand pit near the university town of Heidelberg yielded a massive human jaw which looked like a plausible progenitor of the Neanderthaloid race. This mandible

was referred to the first or second interglacial period, many scores of thousands of years before the flourishing of the Neanderthals. Also in 1892 a Dutch scientist had unearthed a most extraordinary humanoid fossil in the island of Java, apparently dating from the beginning of the Pleistocene period or the end of the Pliocene. This specimen consisted of a very apish skull-cap, too large for any existing anthropoid ape and too small for any man except an idiot, a few ambiguous teeth, and a thigh-bone which certainly belonged to an erect biped. This thing was christened *Pithecanthropus erectus*, "the erect ape-man," and was generally conceded to be Nature's finest effort in the production of a "missing link." Without unduly stretching phylogenetic possibilities, one might conceive of *Pithecanthropus* as a late survivor of a stock which had already crossed the threshold of humanity, having achieved erect posture and biped, without as yet having attained a full quota of brain. It was further possible to suppose that some *Pithecanthropidae* with superior genes had produced the higher Heidelberg type, which again, stimulated by the Kultur of the Pleistocene, ultimately evolved the Neanderthals. These last, in the throes of species parturition, were held by some to have given birth to modern man, apparently themselves expiring with the effort. These were the short and simple annals of the poor Hominidae. It is true that certain recalcitrant Thomases had interposed doubts, calling attention to various skeletal finds which suggest that morphologically modern man existed in Europe even before the advent of the Neanderthals, and asserting that *Pithecanthropus* was a palaeontological monster fortuitously assembled from spare parts of men, apes, and microcephalic idiots.

However, about the time that the politicians were stirring up a world war, an inquisitive amateur geologist trespassed upon a small gravel pit in a Sussex lane near Piltdown Common, and disinterred some skull fragments which were subsequently named *Eoanthropus Dawsoni*, but might better have been called Pandora. The brain-case of this early English female, although of extraordinary thickness, was of essentially modern configuration and of capacious size, lacking low forehead and great brow-ridges, whereas the half of the mandible discovered was chinless and almost indistinguishable from that of a chimpanzee. There was also included in the Piltdown remains a tusk-like projecting canine tooth. Hence, if the associated remains were assigned to one individual, it was necessary to suppose that at the beginning of the Pleistocene period, there existed a type of man with a modern brain-case and a projecting, chinless, ape-like jaw. Such a being could not be fitted into the line of descent which includes *Pithecanthropus*, Heidelberg man, and the Neanderthal race, since all of these fossils were probably provided with large brow-ridges and receding foreheads. Some authorities attempted to solve the problem by supposing that the brain-case and the mandible belonged to two different individuals—one a man, and the other a chimpanzee. But this supposition involved an incredible stretching of the long arm of coincidence. Although it was rejected by the majority, few seemed to possess the imagination to grasp the implications of this radically disharmonic type of fossil man, and to deduce from it the logical conclusions

as to human descent. Almost alone, Sir Arthur Keith committed himself unhesitatingly and definitely to the theory that human evolution has been a multiple and asymmetrical process, involving the differentiation of a number of distinct genera and species of man, of which *Pithecanthropus*, Heidelberg, and the Neanderthaloid group represent lines which are not directly ancestral to *Homo sapiens*. According to this view, Piltdown man (*Eoanthropus Dawsoni*) represents a survival into the Early Pleistocene of a Pliocene form which had already developed modern brain size, but had not as yet undergone the reduction of the jaws and the refinement of the dentition characteristic of morphologically modern man.

One of the cardinal tenets of Sir Arthur Keith's position was his defense of the Early Pleistocene dating claimed for the Galley Hill man, a skeleton discovered in the 100-foot gravels of the Thames Valley as early as 1888. The bones were those of a short-statured adult male with no especially apelike features. The skull is very long and narrow, without excessive development of brow-ridges or of frontal slope; the jaw has a well-developed chin and the teeth are not extraordinary. This find is merely the most famous of a fair number of morphologically modern human bones for which Middle Pleistocene or earlier age has been claimed. All of these finds had been rejected by the majority of anthropologists on the explicit ground that their geological provenience was questionable, but implicitly because of the belief that the occupation of Europe at the end of the glacial epoch by apelike Neanderthals delimited the extent of human evolution at that period. It was then inconceivable that an anatomically modern type should have ranged Europe one or two glacial cycles previously.

In the meantime fresh discoveries seemed to substantiate the opinion that modern man must have evolved through a generalized Neanderthaloid stage. In 1921 the Rhodesian man was exhumed in South Africa—a specimen which in size of face and upper jaw exceeded any human type previously known, and which, in the hugeness of its brow-ridges, virtually out-gorillaed the gorilla. Yet this skull displayed also a mixture of anthropoidal and modern human features, and the limb bones uncertainly associated with it were those of a recent type of man. Nevertheless, most authorities elected to classify Rhodesian man as a variant of the Neanderthal type.

Then came the series of discoveries in Peking, China, beginning in 1927 and closely associated with the industry and scientific acumen of the late Prof. Davidson Black. The *Sinanthropus* crania, of Lower Pleistocene date, are of an evolutionary status intermediate between that of *Pithecanthropus erectus* and the well-known Neanderthal race, although possibly neither the descendants of the one nor the progenitors of the other.

Certain other new discoveries might be interpreted as consistent with the hypothesis that *Homo sapiens* has evolved through a Neanderthaloid stage. These include the Galilee and Steinheim crania, the skeletons from the Wady-al-Mughara in Palestine, and the so-called *Homo Soloensis*—the latter including several Late Pleistocene crania recovered near the same site which yielded

Pithecanthropus erectus. Most of the finds just enumerated have not yet been described adequately. Incomplete information indicates that several of them show a mixture of Neanderthaloid characters with those usually found in *Homo sapiens*. For example, the series of nine Palestinian skeletons, at present not yet disengaged from their stony matrices, are said to combine truly Neanderthaloid frontal tori with high skull vaults, low attachments of the nuchal musculature, well-developed chin eminences, and limb bones of modern conformation. If these preliminary indications are substantiated it is evident that at least three possibilities must be considered: (1) that these skeletons represent Neanderthal man evolving into *Homo sapiens*; (2) that they are hybrids between Neanderthal and some form of *Homo sapiens*; (3) that certain skeletal characteristics, usually regarded as peculiarly Neanderthaloid features, were sporadically distributed through a number of separately evolving human stocks.

Most recently, however, there has been announced a portentous discovery, which, if completely validated, should once and for all relegate such forms as *Sinanthropus*, Heidelberg, and all of the Neanderthaloids to the blind alleys branching off from the main highway of human evolution. These new remains were recovered from a site on the south side of the Kavirondo Gulf of Victoria Nyanza, British Africa, by the English archaeologist, L. S. B. Leakey. At Kanjera were found fragments of three skulls, in a stratum which yielded implements of the Chellean type of industry, and fossil bones which seem to date the deposit from the Middle or Early Pleistocene. While complete reports are not yet available, it is stated that all of these fragments belong to a type of man devoid of a supraorbital torus and in no wise distinguishable from *Homo sapiens*, except in the retention of certain infantile and primitive characters. At another and older site, Kanam, a fragmentary human mandible was found *in situ* in a stratum characterized by fauna which must be at least Lower Pleistocene if not earlier in date, together with stone tools of a pre-Chellean type. This mandible is pronounced by the finder to be very similar to that of *Homo sapiens*, and quite possibly an ancestral form. Thus it is wholly probable that here at last we have the complete vindication of Sir Arthur Keith's opinion of the high antiquity of *Homo sapiens*. We may then have to rescue from the Potter's Field of human palaeontology, Galley Hill, Olmo, Castendolo, and I know not what other dusty and neglected bones, and accord them their rightful place in the gallery of our early ancestors.

While the scientists have been steadily adding to the number of accredited remains of fossil man in the Old World, during the past quarter of a century that formidable and indomitable veteran, Dr. Ales Hrdlicka, has stood like Horatius at the land bridge between Asia and North America, mowing down with deadly precision all would-be geologically ancient invaders of the New World. In fact the story of alleged fossil man in America is virtually the tale of how well Hrdlicka kept the bridge. With penetrating analysis and devastating criticism he has annihilated *seriatim* the claims of each successive fossil pretender. Undoubtedly he has preserved science from a credulous acceptance of many spurious Pleistocene Americans. It is indeed passing

strange that, if man really inhabited the New World during the Pleistocene epoch, we have not found his implements and his bones *in situ* in indubitably Pleistocene deposits, and associated with extinct animals which do not incur the suspicion of having survived into recent times.

A reliable authority upon the present status of the problem of man's antiquity in the New World, the palaeontologist, Alfred S. Romer, says:

"The association of man in America with certain fossil forms is unquestioned, and there is a growing body of evidence strongly suggesting his contemporaneity with a considerable number of mammalian types no longer living. Such contemporaneity, however, by no means indicates any remote geological antiquity for man on this continent, and there is at present almost no palaeontological evidence suggesting his presence here at a time earlier than that of the withdrawal of the last Pleistocene ice-sheet."¹¹

The canny and conservative archaeologist, N. C. Nelson,¹² is even more pessimistic and positive in reaching a similar conclusion.

Nevertheless, evidences suggesting a considerable antiquity of man in the New World keep cropping up, and each succeeding growth is tougher and harder to trample down. There is, for example, the case of Minnesota Man, who appears to have been a young lady who fell into a lake which preceded the post-glacial lake Agassiz, and whose remains, sealed under a concrete highway, were brought to light by the combined efforts of Jack Frost and a road-scraper. This young woman, although of an ordinarily modern appearance in most features, nevertheless possessed teeth and jaws of altogether exceptional size—quite outside of the range of civilized debutantes. Her doughty champion, my friend Professor A. E. Jenks, is now engaged with his colleagues in a definite report upon her anatomical characteristics and the geological circumstances of the find. This discovery calls for consideration by a commission of impartial experts from every field of science concerned. Meanwhile we must not blackball Miss Minnesota, but rather put her on the waiting list.

If the recent discoveries in the Old World prove an Early Pleistocene existence of *Homo sapiens*—or morphologically modern man—it is no longer possible to discredit the geological antiquity of fossil American finds on the sole ground that they do not exhibit Neanderthaloid features or other morphological characteristics unmet in the recent American Indian. It is indeed conceivable that we, like the cheering Romans who remained on the safe side of the Tiber, presently may be impelled to shout "Back Ales! Back Hrdlicka! Back ere the ruin fall!"

¹¹ Jenness, Diamond, Editor, *The American Aborigines*; Romer, Alfred S., *Pleistocene Vertebrates and their Bearing on the Problem of Human Antiquity in North America*, Toronto, 1933, p. 81.

¹² Jenness, Diamond, Editor, *The American Aborigines*; Nelson, N. C., *The Antiquity of Man in America in the Light of Archaeology*, Toronto, 1933, p. 130.

WHAT RACES ARE AND HOW THEY ORIGINATE

Some of us less favored or more meagerly gifted physical anthropologists have neither fossil apes nor fossil men, but must content ourselves with the common or garden varieties of *Homo sapiens*. The study of race can occupy the liveliest intelligence, since race is no dead issue. It abides yesterday, today, and forever.

At the onset of the twentieth century anthropology had barely shaken itself loose from spurious notions of race based upon language, geographical areas, and national boundaries. Gradually there had become dominant a zoological conception of races as varieties, each characterized by the common possession of combinations of featural variations inherited from related ancestors. Race was the individual's less immediate physical heritage.

Here is no place to relate the ludicrous yet tragic history of the prostitution of the scientific conception of race to base political motives, to religious intolerance, and to economic advantage. There can be no doubt, however, that progress in the scientific studies of human races has been obstructed by a vicious misuse of this important field of anthropological research. This perversion has gone on until the very term "race" has become a stench in the nostrils of most fair-minded and intelligent individuals. Nevertheless, in countries where liberty of speech, thought, and action is still permissible, considerable progress in the analysis of race has been made during the past two and one-half decades.

Earlier classifications of race by physical criteria were largely based upon the variations of a few features, the hereditary transmission of which was naively and uncritically assumed.

In the early part of this century certain advances in biology began to influence and to stimulate the study of race. The first of these was the rediscovery of Mendel's Law of Heredity. When botanists and zoologists began to investigate inheritance in plants and animals, to tabulate the results of breeding experiments, and to formulate rules whereby the transmission of physical features became predictable, the application of these findings to anthropological studies was imperative. The first effect of the genetic influence in physical anthropology was to force the student of race and of human heredity to develop a minute and exhaustive system for classifying immensurable morphological variations in man. For example, the rough categorization of hair color into light, medium, and dark classes was obviously inadequate for any serious investigation of inheritance. Since it quickly became apparent that Mendel's laws of heredity concerned themselves with numerous small unit characters, it became necessary for the anthropologist to go beyond records of more or less composite dimensions, arbitrary indices, and crude classifications of morphological features. He was now forced to examine meticulously and to grade and measure as accurately as possible every variation of each physical feature which might be of potential value as a criterion of race.

Experimental genetics forced students of man, and particularly of race, to consider seriously, almost for the first time, whether the characters which

were relied upon for racial classification were really heritable features or merely similar adaptations. In opposition to the genetic viewpoint there arose a powerful school of environmentalists, who were in revolt against Nordic propaganda, and who subjected the supposed immutable hereditary criteria of race to a destructive criticism. Here we may recall the classic study of Professor Franz Boas, in which he demonstrated changes from the parental type in the American born offspring of European immigrants. For instance, the children of dolichocephalic aliens became perceptibly less long-headed, whereas those of brachycephalic antecedents suffered a diminution of relative head-breadth.¹³ Apparently children changed their head-form with their birth-place. Somewhat later A. Ivanovsky recorded a series of modifications which took place in Russian populations, somewhat callously measured before a famine, during it, and, if they were alive, after it. Besides the shrinkage of most bodily dimensions, a number of these hapless Russian groups showed a relatively greater decrease in head breadth than in head length, thus becoming somewhat more dolichocephalic or, literally, less fat-headed. However, this remarkable study also showed the resilience of head form under environmental impact, since these famine-stricken Russians resumed their regular meals and their original cephalic indices almost simultaneously.¹⁴

Again, Arthur Thomson and L. H. Dudley Buxton offered evidence that the relative breadth of the nose (the nasal index) depends upon the environmental factors of moisture and humidity. Their theory was that a narrow nasal aperture is an adaption to a cold dry climate, since it limits the intake of air to such amounts as may be sufficiently warmed in the nasal passages, thereby preventing the respiratory organs from being unduly chilled. Thus the fresh air-loving Englishman opens wide the window, but closes his nose to the merest crack. Conversely, broad nasal apertures are suitable for snuffing up generous drafts of warm moist air, and the Negro extensively ventilates his interior. These authors accordingly attempted to show that mean nasal index could be predicted from mean annual temperature.¹⁵ This effort was moderately successful and seemed to show that the form of the nose was to some extent an adaptation to climate. A New Englander on this theory should develop automatically expanding and contracting nares, controlled by some somatic thermostat.

Environmentalist onslaughts upon racial criteria, however, have in no single instance terminated the usefulness of any standard measure of race differentiation. What the environmentalists have demonstrated is that over longer or shorter periods of time features which are hereditary in a stock are likely to be modified to some extent in response to functional needs, or through sheer perversity. They have merely applied a harsh and well-deserved castigation

¹³ Boas, Franz, *Changes in Bodily Form of Descendants of Immigrants*, Am. Anth. Vol. 14, 1912, pp. 530-562.

¹⁴ Ivanovsky, A., *Physical Modification of the Population of Russia under Famine*, Am. J. of Phys. Anth., Vol. VI, 1923, pp. 331-353.

¹⁵ Thomson, A., and Buxton, L. H. D., *Man's Nasal Index in Relation to Certain Climatic Conditions*, Journal of the Royal Anthropological Institute, Vol. LIII, 1923, pp. 92-123.

to rabid hereditarians who have assumed, without taking the least pains to investigate the matter, that physical features in man are solely the result of germinal combinations.

Another notable advance in racial anthropology was again the indirect result of the interest in genetic studies stimulated by the Mendelians. Virtually nothing was known about the physical effects of race mixtures at the beginning of the century. There was indeed a certain mass of speculative and romantic literature concerning race mixture, wherein were enshrouded the casual observations of travellers, the partisan pronouncements of the prejudiced, and the theoretical ruminations of scientists. But almost no contributions of appreciable scientific merit were existent, except the work of that great pioneer, Franz Boas,¹⁶ upon the half-blood Indian, and a small but valuable study of Edgar Thurston upon Eurasians.¹⁷ In 1913 there appeared Eugen Fischer's¹⁸ excellent monograph upon the crosses between Boers and Hottentots in South Africa—the first attempt, so far as I am aware, to examine in detail the familial inheritance of racial characters in a hybrid stock. Following this there came the work of Dunn and Tozzer¹⁹ upon racial mixtures in Hawaii—a prelude to more extensive studies in this island group by Sullivan,²⁰ Wissler,²¹ and Shapiro.²² The last named also contributed a splendid monograph upon the Norfolk Islanders, descendants of the mutineers of the warship *Bounty* and of Tahitians—a historic example of miscegenation in which current fiction has aroused a renewed interest. G. D. Williams²³ followed with a painstaking examination of the results of mixtures between Spanish and Maya Indians in Yucatan, Rodenwaldt²⁴ with a meticulous study of Dutch-Kisarese hybrids in the Indo-Malayan region, while crosses between various European stocks with the Negro in the New World were investigated by Davenport and Steggerda,²⁵ Herskovits,²⁶ Day,²⁷ and others.

As a result of these and other studies of miscegenation we can now put forward certain generalizations, which of course may be subject to future emendation or possibly to contradiction. These may be stated briefly:

¹⁶ Boas, Franz, *The Half-blood Indian*, an anthropometric study, *Pop. Sci. Monthly*, Vol. XLV, No. 6, Oct., 1894, pp. 761-770.

¹⁷ Thurston, Edgar, *The Eurasians of Madras and Malabar*, *Bull. of Madras Gov. Mus.*, Vol. II, No. 2, 1898, pp. 69-114.

¹⁸ Fischer, Eugen, *Die Rehobother Bastards und das Bastardierungs-problem beim menchen*, Jena, 1913.

¹⁹ Dunn, L. C., *An Anthropometric Study of Hawaiians of Pure and Mixed Blood*, based upon data collected by Alfred M. Tozzer, *Peabody Mus. Papers*, Vol. XI, No. 3, 1928.

²⁰ Sullivan,

²¹ Wissler, Clark, *Growth of Children in Hawaii*, based on observations by Louis R. Sullivan, *Bishop Mus. Mem.*, Vol. XI, pp. 105-257, Honolulu, 1930.

²² Shapiro, H. L., *Physical Characteristics of Ontong Javanese: contribution to study of non-Melanesian elements in Melanesia*, *Am. Mus. Papers*, Vol. XXXIII, pp. 225-278, N. Y., 1933; *Descendants of the Mutineers of the Bounty*, *Bishop Mus. Mem.*, Vol. XI, pp. 1-106, Honolulu, 1929; *Race Mixture in Hawaii*, *Nat. Hist.*, Vol. XXXI, pp. 31-48, N. Y., 1931.

²³ Williams, G. D., *Maya-Spanish Crosses in Yucatan*, *Peabody Mus. Papers*, Vol. XIII, No. 1, pp. 1-247, 1931.

²⁴ Rodenwaldt, E., *Die Mestizen auf Kisar*, 1927.

²⁵ Davenport, C. B., and Steggerda, M., *Race Crossing in Jamaica*, *Carnegie Inst. of Washington*, Pub. No. 395, 1929.

²⁶ Herskovits, M. J., *The American Negro*, pp. 3-82, 1928.

²⁷ Day, C. B., *A Study of Some Negro-White Families in the United States*, pp. 1-126, 1932.

(1) Crossings between races which are physically widely diverse do not result in any diminution of fertility, either in the first filial generation or in their subsequently inbred offspring. On the contrary, miscegenation seems to be attended by increased fecundity.

(2) No satisfactory evidence has been adduced in favor of the supposition that racial hybrids sprung from wide crosses are inferior in vigor or in vitality to the parent stocks which have produced them.

(3) The alleged occurrence of physical and mental disharmony in hybrids has not been substantiated by any considerable body of evidence. There is frequently a maladjustment of the hybrid population, but it is sociological and not biological.

(4) While it is clear that many morphological features are transmitted according to Mendelian laws of heredity, it is obvious that simple unit inheritance of morphological and indicial criteria of race does not apply. Unit characters are small and multiple for almost every feature. Segregation and dominance occur, but the genetic situation is usually so complicated that it cannot be tested by the application of rules of Mendelian expectation.

Genetic analyses of race mixtures have also affected methods of racial classification and conclusions concerning racial origins. Indeed it now becomes clear that hybridization has played a leading rôle in race differentiation. Observation of the inheritance of racial features in contemporary wide crosses has taught us to identify stabilized hybrid combinations of features in the individual, and has enabled us to dissect composite races. We must now admit that the majority of the great human groups which have been accorded racial classification are not the results of evolution acting upon pure inbred lines, but rather the end products of outbreeding followed by intensive inbreeding and selection. Indeed, even the noble Nordic race is not free from the suspicion of a bar sinister upon its escutcheon. It seems wholly possible that the Negro race alone can fling about the term "bastard" with an absolute certainty that it is not shying pebbles in a vitreous domicile.

Another notable advance in racial studies has been due to the development and application of biometric methods. The lion's share of the credit for this achievement must go to Professor Karl Pearson, the monarch of the statistical jungle whose hunting trail we humbler denizens follow at a respectful distance, despised as a pack of unmathematical hyaenas, but nevertheless avidly devouring his kills.

In the pre-Pearsonian era almost all physical anthropologists were content to estimate the anthropometric status of any group principally from arrays of raw means of isolated characters. Little attention was paid to dispersion or variability and practically none at all to the adequacy of samples. The interdependence of variables was usually disregarded. Kindergarten arithmetic was generally thought to suffice.

Professor Pearson has invented many fine statistical tools whereby anthropometric series may be thoroughly analyzed. If some of us use them improperly

in our ambitious ignorance, we, at any rate, accomplish more than we did with our bare hands. The fork is an admirable implement for table use, even if one insists upon picking one's teeth with it. The greatest boon of the biometric school to the anthropologist was the method of dealing with the sampling problem. Since it was discovered that most anthropometric characters are distributed in an approximately normal fashion, it became possible to utilize the mathematical properties of the normal curve to gauge the reliability of the constants of small samples. Now when an anthropologist wishes to determine whether the differences between two groups are statistically significant, or merely due to chance, he can approach the task with some confidence. Other statistical devices have contributed in the transformation of physical anthropology from a more or less futile recording of unintelligible measurements to something approaching a mathematical science of analyzing biological data. It is of course true that some mathematically gifted persons, lacking a proper knowledge of anthropological objectives, have frittered away the pages of scientific journals, playing aimless and endless games with formulae and equations.

It would be hard to exaggerate the importance of modern mechanical inventions in facilitating anthropometric studies. In the days of hand calculation no anthropologist with any foresight would attempt to gather data pertaining to really large groups of individuals, because he knew very well that the sheer drudgery of the arithmetic involved in the reduction of these data would preclude every possibility of a complete analysis. Therefore the wise virgins made brief and rapid forays into the field of investigation, making sure that they went no farther and no longer than the oil in their lamps would last. On the contrary, some foolish virgins found their lamps extinguished when they were still far afield. Now electric calculators have reduced the arithmetical labor to such an unbelievable extent that the anthropologist faces with complete equanimity series consisting of thousands of individuals, whereas previously he quailed at hundreds. Consequently modern anthropological investigations are both more extensive and more intensive than was possible in the pre-mechanical age, and the results are proportionately more reliable.

One of the defects of method in racial classification and racial analysis incident to lack of mechanical apparatus for the reduction of mass statistics, was the practice of judging racial characters by means of isolated measurements and by percentages of observations taken singly. If an investigator found that the average stature of a group studied was tall, that a large proportion of the group had dark eyes, and that the mean of the cephalic index was seventy-five, he was inclined to assume that the majority of individuals in his group were characterized by a combination of tall stature, dark eyes, and dolichocephaly. Actually the assumption that mean group values of metric features and modal categories of variations of morphological characters are linked together in the majority of individuals, is usually incorrect. This method has led to the setting up of fictitious racial types. It has resulted in erroneous racial classifications. Until a few years ago there was available no

means of exploring actual combinations of racial criteria in large groups of individuals, except by an endless and maddening process of hand-sorting. Now, however, it is possible to utilize electric sorting and tabulating machines, whereby the data concerning each individual are punched into a single card, and thereafter any desired combination of characters, however intricate, may be selected and counted automatically with incredible rapidity. Service bureaus in large cities do this work at very reasonable rates. When the numerically adequate samples of each racial group, which are now being gathered over the world, are subjected to exhaustive analysis by the use of these mechanical devices, we may hope to establish definitive scientific racial classifications which will endure.

It should be clear to every thinking person, however, that until the physical delimitations of races are definitely determined, any attempt to study their psychological characteristics or their varying capacities for cultural achievement must be wholly futile. At present assertions of racial inequality and of racial equality are alike unscientific.

This brings me to the latter query of my subject "Whither Homo sapiens?" There can be no doubt that studies of races, groups, or individuals, which confine themselves purely to physical description and analysis are comparatively, if not absolutely, sterile. Is anything known of the cultural implications of physique either in the individual or in groups? In the past two decades a number of extensive researches have dealt with the problem of such correlations. Many growth studies of school children have shown that physical superiority is definitely associated with superior scholastic aptitude. Mental deficiency is commonly associated with inferior physique. In 1913 Charles Goring conclusively demonstrated that English criminals, as a group, are vastly inferior in physical development to the law-abiding population. My own weary researches upon the American criminal in ten states are even more decisive. While the complete results cannot yet be divulged to a none too impatiently waiting public, it can be stated positively that the biological inferiority of the criminal is no less marked than his economic ineffectiveness and his general stupidity.

We are faced by the sinister necessity of ascertaining whether or no man's most benevolent cultural efforts—medical science and idealistic humanitarianism—are eating him alive by eliminating the evolutionary effect of natural selection. Natural selection is a sort of automatic surgery whereby malignant phylogenetic growths are excised. It is the most effective preventive of stock contagion, since it extirpates the infected.

On the whole, the physically well endowed are likely to have better mental equipment than constitutional inferiors. But it seems certain that one important effect of modern medical practice is to preserve the lives of the weak and the mentally unfit, thereby permitting them to reproduce more of their kind. Thus the average quality of the population is lowered. Medical science is virtually impotent to deal with mental disease or deficiency. It therefore

(Please turn to page 29)

"OLD FEATURES OF THE NEW DEAL"*

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Human freedom is of three degrees, political, religious and economic, and the effort to attain some measure of such freedoms has been with man from the beginning and will follow him to the end. No large civilized nation has yet been able to attain full freedom in all three degrees. The bloody story of man's effort to attain political and religious freedom with its awful toll of human lives needs no rehearsal here except to note how difficult it is to win such freedoms and how easy it is to lose them as illustrated by the events in Russia and certain European countries in the last few years. Political and religious freedom is enjoyed in only a very few lands today, and ours is one of them. Let us see to it that we do not lose them.

By economic freedom I mean freedom for all from poverty and all of its accursed results; freedom through the conquest of our material surroundings so that all men may live as men and not as beasts, and freedom to enjoy at least some of the finer things of life free from the haunting fear of unemployment, want, hunger and the despair that has always been the lot of a large part of mankind.

So far as the great mass of humanity is concerned economic freedom has always been an idle dream and it was not until the advent of modern methods about 1800 that any hope whatever of universal well-being was offered to mankind. Any account of the growth of modern industrial and scientific methods has no place here but it must suffice to state that by 1900 it is commonly agreed that for the first time in the history of man he could produce more food, more clothes, more houses, more of everything required by human wants than was needed and economic freedom was a possibility so far as the methods of production are concerned. The average well-being in this country in the early part of this century was probably the highest ever attained by any great civilized country and what we might have done with this new power in times of peace we shall never know. The great war with its disjuncting effects, the tremendous expansion of our industrial equipment which resulted, and the false prosperity that followed all came at a most inopportune time and as we crawl out of the debacle of 1929 the world is filled with confused thought and innumerable panaceas for our relief and for the prevention of future depressions. We are told that the world is basically changed, and that never again can we hope to see anything like the good old times unless we make the most radical changes in our political and social economy. Some time ago Mr. Bancroft Gherardi, Chief Engineer of the American Telephone and Telegraph Company, published a collection of articles written at the time of the several depressions in this country going back to the early part of the last century. With a change of date any and all of these dark prophecies

* An address before the Swarthmore Chapter.

could be substituted for many of our current writings and few would know the difference.

Now, of course, the world is changing and has been changing ever since the Industrial Revolution. The new industrial and scientific methods have tended constantly to separate the worker farther and farther from the ownership of his tools, they have separated agriculture from the mechanic arts to the degree that what benefits one group may not help the other. These new methods have broken up old trades and have created many new callings and they have created more jobs than they have destroyed. Without doubt they have made the world a much more complex place and the industrial machine to which we are all bound hand and foot is much more delicately balanced than it was and hence much more easily thrown out of adjustment. But in spite of these drawbacks, it should be remembered that these new methods are the only ones ever devised that are capable of giving us economic freedom. To say that we cannot control this industrial machine in the interests of all is to admit our mental inadequacy. It will not be easy to do, but I believe it can be done.

It should be remembered, however, that all advances, whether industrial, political, or religious are, and always have been, accompanied by trouble and suffering. It appears to be inevitable that no great reform or betterment can be accomplished without suffering upon the part of many. I would remind the critics of modern industry that such political and religious freedom as we enjoy were won literally through blood and tears; that these liberties are retained even now only through constant watchfulness and that there is no lack of people who would like to see a return to old political and religious organization just as many critics of modern industry preach a return to mediaeval handicraft, or at least a large abatement of modern methods. Make no mistake in this matter. If we shall achieve economic freedom, a high standard of life, security and delight in work and leisure, as we have to some degree achieved political and religious freedom, it will be through much trouble and against no little opposition.

The several methods that are now being tried in Europe to cure modern industrial and social ills are worthy of more than a passing thought. We are not likely to adopt communistic methods in this country though we may enlarge our ideas of government ownership as regards some common necessities. Nor are we likely to permit the development of any form of dictatorship. It should be remembered, however, that as pointed out over two thousand years ago by Greek philosophers, the cycle of government is from a democracy to an oligarchy, from an oligarchy to a dictator, and through a violent upheaval from a dictator back to a democracy and so on. A dictatorship might indeed solve some of our industrial problems, but a dictatorship whether by a minority group or an individual is always subversive of political freedom and usually subversive also of religious freedom. We shall do well to guard carefully the right to go to the polls periodically and change our rules as we deem wise. Economic freedom at the expense of political and religious freedom would avail us very little.

What really is happening so far as the NIRA is concerned is an extension of the legal control of industry, a principle established many years ago. We

hear much of the passing of laissez-faire and "rugged individualism" because of the "New Deal." Such remarks display dense ignorance of the history of labor legislation during the past 100 years. As a matter of fact laissez-faire has never been anything more than an economic theory, in civilized lands at least, and while no doubt there are many compensating characteristics in modern industrial economics no modern nation has been willing to trust to them to guard, for instance, the welfare of the working classes. The greatest curb ever put upon rugged individualism was the anti-trust legislation of the latter part of the last century and history abounds with illustrations of legislation by the majority to control the minority. A mere glance at the industrial legislation of our older industrial states will verify this statement. Experiments such as we are now trying are very ancient. The Code of Hammurabi promulgated about 4,400 years ago fixes the rates of pay for doctors, veterinarians and all kinds of artisans and in many other ways regulates industry exactly as we are trying to do today. History does not tell us what success he had with his code. The Statute of Laborers enacted in England in 1349 and which, many times amended, was operative until the Industrial Revolution originally fixed the minimum working day at twelve hours and otherwise legislated in favor of the employer rather than worker. Modern industrial legislation beginning with the English Factory Act of 1812 has tended to regulate industry in favor of the worker and the public and the NIRA simply extends the principle. In so far as it tends to eliminate abuses such as racketeering, unfair competition and child labor, all thinking men will applaud the Act as a progressive step. It remains to be seen how far we can regulate industry and yet retain private initiative and secure the beneficial results of modern productive methods.

It is at this point that we run up against the economics of the new deal so called. Setting aside the monetary problem which I am not competent to discuss, and admitting that higher prices are desirable, I know of no economic theory that justifies the destruction of food supplies and the restriction of output in order to supply food and clothing to the multitude. And the avowed plan of the President on the one hand to raise prices and the frantic appeal of General Johnson on the other to keep prices down somehow do not seem reasonable, especially when no explanation of the discrepancy is attempted. The Public Works program is no doubt sound and very necessary, and I am perfectly willing to pay my share of processing and other taxes in order to redistribute the national income, though in many instances a premium will be placed upon inefficiency and shiftlessness, especially among the farming community.

But I am more disturbed over what Dr. Virgil Jordan has called the "anti-industrial complex" or the belief on the part of many that modern industrial methods are a menace to our national life and should be curbed; a belief that those who manage industry have obtained the lion's share of the benefits as compared to the actual worker and the farmer. Out of this belief has grown the general attitude toward industry (now evidenced by those who are directing our governmental destinies). No doubt there is some truth in the charge and unfortunately a few cases of lack of rectitude in high places has added strength to this accusation. But there are only two horns to this dilemma. Either we

must go to outright governmental ownership with its mediocre initiative and leadership, or continue to depend upon individual efforts. Now the proportion of men in any group, great or small, who are competent to initiate and manage large enterprises of any kind is very small. In a similar way the scientists and engineers constitute a very small percentage of the population. This group can be regulated and regimented just so far and still produce their best results. Genius does not work well in harness and the old law of diminishing returns applies here as elsewhere and if regimentation is pressed too far the result cannot fail to be as thus described by Dr. Virgil Jordan:

"In the first place, and most fundamentally, it must lead to a gradual lowering of the standard of living, or at least to a greatly retarded rise in the standard of living. The economic welfare of any nation is dependent basically upon its output of work, the volume of goods and services or real wealth that it produces. We may shift debt burdens from one group to another and artificially redistribute wealth and income; but no nation can raise its standard of living merely by raising prices and wages through monetary manipulation or group agreement, or through curtailment of output, restriction of production effort. The most important factor in the productive accomplishment of any people is the enterprise and effort of individuals, as investors, speculators, inventors, organizers, and managers. The crippling of individual initiative and enterprise through the expanding control of bureaucratic agencies must inevitably lower the level of effective production, restrict opportunities for employment, and reduce the standard of living."

These are thought provoking words. The greatest asset that any nation can possess is the skill, knowledge and initiative of its industrial and business leaders and probably we can better afford to put a few of our too ambitious leaders in the penitentiary occasionally rather than exterminate or suppress the entire group.

In any case, we are due soon to find out how far we can legislate ourselves into prosperity or rather we shall find out perhaps how far we may assist natural economic laws through legislation. And the experience may be trying for many of us.

Furthermore, we are embarking upon a grand crusade to compel men to be just and fair. The NIRA heads in that direction and there are not a few exponents of the new deal who would go much farther in an effort to obtain greater social justice. The intent is good, but the difficulties are great. If all men were just and fair we should have no need of legislation such as the NIRA. But unfortunately this country contains a vast number of people in whom justice does not reside and who do not hesitate to take advantage of their neighbors, even though they may transgress the law. It will require an immense police force to keep these people in line, so much so that it may cost more than it is worth. Our recent experience with prohibition was a typical experience. It is difficult to legislate goodness into the heart of unregenerate persons. On the whole we have made much progress toward a more enlightened and fairer industrial system during the last century and our greatest hope lies not in

legislation but in higher ethical standards on the part of those who control industry, commerce, and banking.

And again there is nothing new in this. Plato tells as an ancient Greek myth how the great god Zeus bestowed reason and fire upon men so that they could hold their own against nature and the beasts of the field. But men were not able to live with themselves because of their vicious temperaments. Zeus, therefore, sent Hermes to distribute Justice and the sense of shame in every human heart for he said without these in every heart men would eventually exterminate themselves. This would appear to still hold true and perhaps what we most need is not legislation but higher ethical standards upon the part of all of us. But I fear that is a long, long road.

Homo Sapiens—Whence and Whither

(Concluded from page 24)

patches up the bodily ills of the mentally diseased and insures their opportunity to perpetuate their taints.

One of the principal teachings of current religious and social philosophy is, in effect, that all human life is sacred and that man's highest mission is to preserve it, however worthless it may be. This well intentioned humanitarianism forces us to expend more and more of our resources for the preservation and increase of that part of our population which is least worthy of existence, and to protect society from the results of its own irresponsible breeding.

We all admit that our social engine has stalled, and a succession of political, economic, and sociological drivers have been pulling and pushing every movable gadget in a futile effort to make it start. May not a biological bystander suggest the possibility that someone has watered the gasoline?

It would be expedient to conclude this survey with an innocuous prophecy of the evolutionary future of man's wisdom teeth, little toes, head hair, and other degenerating appurtenances. It would be inspiring to produce evidence that man's body is evolving into a perfect organism and that his mentality is growing apace like the national debt. Unfortunately, I am unaware of any marked improvement of man's evolutionary status since the end of the glacial period. On the other hand, distinctively regressive or degenerative trends, general to the contemporaneous human species, are possibly confined to a few features of the organism—perhaps notably the dentition. What we must avoid is a progressive deterioration of mankind as a result of the reckless and copious breeding of protected inferiors. We have not the knowledge to breed supermen, but we can limit the reproduction of criminals and mental defectives. Let us cease to delude ourselves with the belief that education, religion, or other measures of social amelioration can transform base metal into gold. Public enemies must be destroyed—not reformed. We need a biological new deal which will segregate and sterilize the anti-social and the mentally unfit. Intelligent artificial selection should replace natural selection.

COLOR-BLINDNESS IN JAPAN

THOMAS R. GARTH
University of Denver

Through the kind cooperation of Dr. Joseph Yoshioka of the Anthropoid Experiment Station of Orange Grove, Florida, and Dr. K. Masuda and Dr. S. Ishihara of the Imperial University of Tokio, measures of color-blindness in Japan and facts about their geographical distribution have been secured by the writer. The data were obtained from two Japanese professional journals and two references.¹

Table I gives the various findings as to the number of subjects examined with the Ishihara color-blindness test, the name of the investigator, the province in Japan in which the investigation was made, and the percentage of color-blindness for sex groups. The following chart provides an inclusive geographical presentation of the facts.



It will be seen that the incidence for male Japanese ranges here from 2.4 percent, as found in Ehime, to 6.9 percent, as found in Aichi, i.e., it appears to be different in the different geographical locations. The question immediately arises as to whether the indicated differences as found are really significant. When we apply the formula ($D/\sigma_{diff.}$) of a test for a difference for two proportions as between each of the percentages, we find that the incidence as found by Sone in Ehime is significantly different from that found in all the other provinces, and that Kawakami's second investigation (1922) in Tokio shows an incidence significantly different from his first investigation in Tokio (1921) and from that found in Aichi in 1917 and 1919 by Takizuka, and in Tokio in Kawakami's 1921 study. (See map for the distribution.) It will be seen that out of these eight studies in Japan the incidence is seen to fluctuate somewhat, depending on geographical distribution and time. If one asks what is the incidence of color-blindness among Japanese, one has to say

¹ Five from the Ophthalmic Clinic (Japan), and three from other sources.

that it is not any single percentage. If one asks if it differs from that found for whites, it can be said that if we take the incidence as supplied from findings in Colorado,² i.e., 8.4 percent, and compare it with the incidence supplied by Goto from Mie, the difference between the two, whites and Japanese, is not significant. But if we compare the white incidence with that supplied by Sone from Ehime, 2.4 percent, the difference is significant.

If we seek to find if the incidence of color-blindness in China, as supplied by Kilborn and Beh,³ is different from that of Goto, and again of Sone, we find that the difference is not real in the first, but real in the second instance.

Altogether we may say that here we have evidence for believing that the difference as found in all of our comparisons are group differences, and not racial differences.

TABLE I
THE INCIDENCE OF COLOR-BLINDNESS IN JAPAN
OBTAINED WITH THE ISHIHARA COLOR-BLINDNESS TEST

Investigator	Province	Males			Females		
		Number Tested	Color-Blind No.	%	Number Tested	Color-Blind No.	%
A. Goto (1915)	Mie	913	57	6.24			
B. Enido (1917)	Kyoto	717	41	5.72	454	3	0.65
C. Takizuka (1917)	Aichi	1,088	71	6.50			
D. Shoji (1918)	Chiba and Tokio	2,780	131	4.71			
E. Takijuka (1919)	Aichi	1,135	79	6.90			
F. Sone (1919)	Ehime	7,455	181	2.40	3,288	18	0.55
G. Kawakami (1921)	Tokio	6,199	353	5.70			
H. Kawakami (1922)	Tokio	6,373	271	4.25	4,981	10	0.25

² Garth, T. R., *The Incidence of Color-blindness Among Races*, Science, Vol. LXX, No. 1996, pp. 333-334.

³ Kilborn, L. G., and Beh, Y. T., *The Incidence of Color-blindness Among the Chinese*, Science, Vol. LXXIX, No. 2037, p. 34.

MINUTES OF THE MEETING OF THE EXECUTIVE COMMITTEE OF SIGMA XI

Pittsburgh, December 28, 1934

The second meeting of the Executive Committee for 1934 was held in the Hotel Schenley, Pittsburgh, December 28, 1934. The meeting was called to order at 2.00 P.M. by President Parker. Those present were: President Parker, Secretary Ellery, Treasurer Pegram, Professor Cole, Professor Stadler, Dr. L. B. Wilson, Mr. C. E. Davies, and by invitation, Dr. Frederick B. Utley of the Alumni Committee, and Professor C. B. Lipman of the University of California. Business was transacted as follows:

1. FORMAL PRINTED PETITIONS:

At the meeting of the Committee held in Washington in April, 1934, it was voted to request the petitioning groups at Smith College in Northampton, Massachusetts, and Wesleyan University in Middletown, Connecticut, to present to the Committee at the December meeting formal printed petitions for charters for chapters. The secretary announced that the petitions had been submitted, and reviewed the considerations which had culminated in this way. After some discussion it was

Voted—That the Executive Committee present to the thirty-fifth annual convention, with recommendation to favorable action, the printed petitions for charters for chapters from (a) Smith College and (b) Wesleyan University.

2. REPORTS FROM OFFICIAL VISITORS:

In accordance with the action taken at the April (1934) meeting of the Committee, President Parker appointed official visitors as follows: to Carleton College, Northfield, Minnesota, Professor R. A. Gortner of the University of Minnesota; to the University of Buffalo, Professor T. R. Wilkins of the University of Rochester; to the University of Florida, Professor J. K. Roberts of the University of Virginia.

The secretary read the full reports presented by each visitor. The complete reports are on file in the secretary's office, together with detailed information about the three institutions.

The secretary presented additional information and comments from Sigma Xi chapters neighboring to the institutions concerned, and a letter from Dean Richtmyer. Professor Cole, Professor Pegram, Doctor Wilson and Professor Lippman also offered suggestions.

The Committee voted as follows:

Voted—a. That the group of petitioners at Carleton College be requested to submit to the Committee at its spring meeting a formal printed petition for a charter for a chapter of Sigma Xi.

b. That action on the informal petition from the group at the University of Buffalo be postponed to the spring meeting.

- c. That action on the informal petition from the group at the University of Florida be postponed to the Spring meeting, and that the secretary be requested to secure further information regarding a possible closer relation between the Experiment Station at Gainesville and the University.

3. SIGMA XI CLUBS:

In view of the action of the Committee in the case of Carleton College, the secretary was requested to prepare and present at the Spring meeting of the Committee information regarding the equipment and resources and attitude to research in the institutions where Sigma Xi clubs are now active.

4. INFORMAL PETITIONS:

The secretary presented the detailed information submitted by:

- a. Wayne University
- b. Oregon State College
- c. Virginia Polytechnic Institute

The president requested the Committee to give the material careful study, and to be prepared at the Spring meeting to express their opinion regarding conditions at these institutions.

5. PRELIMINARY INQUIRIES:

The secretary reported inquiries from fifteen institutions regarding the policy of Sigma Xi in establishing chapters.

6. SIGMA XI ASSOCIATES:

The secretary presented the following resolution submitted by the Yale Chapter:

"Resolved, that the Yale Chapter of Sigma Xi favors the abolition of the grade of Associate Member, and prefers the election of duly qualified undergraduates to full membership in the Society. Resolved, further, that the Secretary of the Yale Chapter be hereby authorized to communicate the resolution to the National Committee and respectfully urge that the question of associate membership be reconsidered."

This important matter provoked prolonged discussion, participated in by all the Committee and those present by invitation. A large portion of the time available for the meeting was given over to a consideration of the present classification of the Society's initiates. Many suggestions were made looking toward change either in the classification or in the designation of the two grades. In the course of the discussion it became apparent that the matter was so important and affected the policies of the Society so profoundly that action could not appropriately be taken at this time. It was

Voted—a. That the resolution of the Yale Chapter regarding the grade "associate" be made a special order of business at the Spring meeting;

- b. That the Yale resolution be reported to the Convention with the request from the Committee for comments and recommendations.

7. INSIGNIA FOR CANADIAN MEMBERS:

The secretary reported that considerable correspondence had passed between the McGill Chapter and his office regarding the cost of the Society's insignia to those elected in that chapter. There is a customs' tax of 45 percent, a sales tax of 6 percent, and an excise tax of 3 percent on the insignia manufactured in the United States and shipped into Canada. Further, the present United States federal regulations governing the shipment of gold out of the United States require that each shipment be accompanied by an affidavit, costing 50 cents, that the shipment is a bona fide Society emblem intended for personal wear and not a shipment of gold for monetary purposes. Thus Canadian members and associates are compelled to pay 54 percent of the purchase price of insignia in addition to the purchase price, and the Society or the jeweler (at present it is the jeweler) the sum of 50 cents for each shipment.

In view of these conditions, it was

Voted—To authorize the secretary, on behalf of the Society, to enter into contract with a reputable manufacturing jeweler in Montreal to manufacture and sell Sigma Xi insignia to Canadian members and associates under the same terms and protecting safeguards now in operation between the Society and its official jeweler in the United States.

8. ELECTION OF MEMBERS BY ALUMNI CHAPTERS:

The secretary called the attention of the Committee to the action taken by the Committee in March 1931 regarding the election of members into the District of Columbia Chapter. By the terms of the national constitution, an alumni chapter may elect members under the eligibility requirements of the constitution with the restriction that the number so elected in any one year shall not exceed a number previously set for the chapter by the Executive Committee. The District of Columbia Chapter was given authority to elect not more than twelve percent of the dues-paying members of the chapter per year for a period of three years. The three-year period expires in March 1934.

The secretary reported that pursuant to that authorization the District of Columbia had elected to membership not more than three individuals per year, and that it was the declared intention of the chapter to continue that policy. The Committee

Voted—That the District of Columbia Chapter be authorized to elect to membership a number of individuals that shall not exceed ten percent of its dues-paying members for the next three years.

9. THE SEMI-CENTENNIAL:

The Committee on the Semi-Centennial program presented a report of possible program for the celebration of this important event in the history of Sigma Xi. (Printed in full in this issue of the *QUARTERLY*, page 4.)

Mr. Davies suggested that the Alumni Committee was considering the advisability of a campaign among the Sigma Xi alumni for a Semi-Centennial

fund of \$50,000.00, the income of which should be used for grants-in-aid of research. At his request, it was

Voted—That the alumni be encouraged and authorized to raise the sum of \$50,000.00 to be known as the Semi-Centennial fund, the income from which shall be used for grants-in-aid of research, and that the first grants be made in 1936.

10. THE ALUMNI COMMITTEE:

Mr. Davies stated that approximately 15,000 alumni members and associates had been circularized at the end of November, and the beginning of December for contributions to the research fund for current distribution in the form of grants-in-aid, and reported that the sum of \$1,300.50 had been received. (At the time of going to press with this issue of the *QUARTERLY* the sum amounts to \$1,927.00.)

Attention was called to the publication in the September issue of the *QUARTERLY* of the awards of grants-in-aid from the alumni fund for 1934-35.

Mr. Davies also reported that the alumni were giving careful consideration to the matter of the organization of alumni chapters throughout the country, with educational institutions where there is now no chapter as nuclei for such groups. It is anticipated that the alumni committee will be prepared to make recommendations at the Spring meeting of the Executive Committee.

11. DATE FOR THE SPRING MEETING OF THE EXECUTIVE COMMITTEE:

It was

Suggested—That a convenient date for the stated Spring meeting of the Committee is in connection with the meeting of the National Academy of Sciences in April; that if possible a day in the period April 21-28 be assigned for the meeting; and that the place of the meeting be determined later by correspondence.

(Subsequent to this action, the Committee has voted through correspondence that the Spring meeting will be held in Washington, April 24 and 25.)

12. GUESTS AT THE APRIL MEETING:

In view of their interest in the Semi-Centennial of the Society and their connection with the Semi-Centennial Committee, it was

Voted—To invite Dr. W. R. Whitney, Dean F. K. Richtmyer, and Mr. C. E. Davies to sit with the Executive Committee at its Spring meeting.

13. THE ANNUAL ASSESSMENT:

It was

Voted—To present to the Convention the following resolution with recommendation for favorable action:

Resolved: That the annual assessment on each chapter for 1935 shall be payable on January 1, 1935, and that the amount of the assessment on each chapter shall be 75 cents multiplied by the number of members and associates of the chapter on January 1, 1935.

Resolved further: That in sending notice of the 1935 assessment to chapter treasurers, the Treasurer of the Society be instructed to advise each chapter that the assessment is to be computed strictly on the basis of the number of members and associates on the membership roll of the chapter, without regard to whether said members have or have not paid current chapter dues, and to explain that this method of fixing the amount of the assessment on each chapter has been adopted by the conventions of the Society as the most equitable to all chapters.

14. ADJOURNMENT:

The meeting adjourned at 4.00 P.M.

EDWARD ELLERY, *Secretary.*

PROCEEDINGS OF THE THIRTY-FIFTH CONVENTION OF SIGMA XI

The Thirty-fifth Convention of the Society of the Sigma Xi was held in the Hotel Schenley, Pittsburgh, December 28, 1934.

1. CALL TO ORDER:

The business session was called to order at 4.00 P.M. by the president, Prof. George Howard Parker of Harvard University.

2. COMMITTEE ON CREDENTIALS:

President Parker announced a Committee on Credentials as follows:

G. E. Grantham, Cornell, Chairman,
P. L. Bayley, Lehigh,
O. C. Boyd (club representative), Massachusetts State.

3. REPORT OF THE COMMITTEE ON CREDENTIALS:

The Committee received the credentials of the delegates, and reported forty-six chapters and six clubs represented as follows:

a. Chapters represented and recorded as voting:

Cornell	Michigan	Mayo Foundation
Rensselaer	Illinois	Iowa State
Union	Missouri	Rutgers
Kansas	Colorado	Kentucky
Yale	Northwestern	Swarthmore
Minnesota	Syracuse	Virginia
Nebraska	Wisconsin	Johns Hopkins
Ohio	University of	New York
Pennsylvania	Washington	Michigan State
Iowa	Purdue	Lehigh
California	District of	Maryland
Columbia	Columbia	Kansas State

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College of Medi- cine, U. of Ill.	Rochester	California at Los
Pennsylvania State	Pittsburgh	Angeles
Oklahoma	Harvard	Massachusetts
Wyoming	Western Reserve	Inst. of Tech.
	Duke	Tulane

- b. Chapters which had reported appointment of delegates, but not recorded as voting: Case, Indiana, Texas, McGill, Cincinnati (five chapters).
- c. Chapters not reporting appointment of delegates, and not recorded as voting: Brown, Stanford, Chicago, Worcester, Washington University, North Carolina, North Dakota, Idaho, Oregon, California Institute of Technology, Arizona, State College of Washington, Princeton (thirteen chapters).

d. Clubs represented: (six)

Ohio University
South Dakota
Alabama
Utah
Montana State
Texas Technological College

e. Officers present:

President Parker, Secretary Ellery, Treasurer Pegram, Professor Cole, Professor Stadler, Dr. L. B. Wilson, Mr. Davies, Doctor Utley.

4. MINUTES OF THE THIRTY-FOURTH CONVENTION:

The account of the proceedings of the Thirty-fourth Convention of the Society at Boston, December 28, 1933, published in the March (1934) issue of the QUARTERLY, was approved as printed.

5. REPORT OF THE PRESIDENT:

See page 40 this issue.

6. REPORT OF THE SECRETARY:

See page 41 this issue.

7. REPORT OF THE TREASURER:

See page 44 this issue.

On request of the Treasurer it was

Voted—That the President appoint auditors to examine and certify the Treasurer's report.

J. T. Finneran and L. Brett, of Columbia University, were appointed as auditors.

8. REPORT OF THE ALUMNI COMMITTEE:

See item 10 in minutes of Executive Committee, this issue.

9. REPORT OF SEMI-CENTENNIAL COMMITTEE:

See page 4 this issue.

10. FORMAL PETITIONS FOR CHARTERS FOR CHAPTERS:

The secretary presented to the Convention formal printed petitions for charters for chapters from Smith College in Northampton, Massachusetts, and Wesleyan University in Middletown, Connecticut. It was

- Voted*—a. That the petition from Smith College be granted.
b. That the petition from Wesleyan University be granted.

11. THE "ASSOCIATE" GRADE:

President Parker reported to the Convention the request of the Yale Chapter and the action of the Executive Committee (item 6 of the Executive Committee minutes, this issue), and asked for comments and suggestions. There was considerable discussion covering:

- a. constitutional definitions of eligibility;
- b. increased opportunities for research by undergraduates;
- c. lack of uniformity in policies and privileges in various chapters. Chapters installed prior to 1922 may or may not elect undergraduates as members at their option; twenty-nine such chapters have chosen to elect associates, six such chapters do not elect associates; twenty-nine chapters installed since 1922 are limited by the constitution to election of undergraduates as associates.
- d. clarification of the term "alumni associate" used in section 1 of Article III of the national constitution.
- e. possibility of election of research workers not connected with institutions where there are chapters, and the status of such individuals when and if so elected.
- f. change of name designating the grades.
- g. additional grades, and other ways of recognizing research ability than by election into the Society.

12. AMENDMENT TO THE CONSTITUTION:

The attention of the Convention was directed to the action of the Thirty-fourth Convention on the proposed amendment to the constitution offered at that time as follows:

The Executive Committee is empowered to elect as associates in the Society students in institutions where there is no chapter of Sigma Xi who have shown marked excellence in two or more fields of science, pure or applied, and to provide for their initiation.

In accordance with the constitutional provision covering amendments, action on this proposal was postponed to the Thirty-fifth Convention. After some discussion, it was

Voted—That in view of the study into the entire question of associateship and membership in the Society which the Executive Committee has in prospect (item 6 of the Executive Committee minutes, this issue, and item 11 of the Convention proceedings) this proposed amendment be laid on the table for consideration at some future Convention.

PROCEEDINGS OF THIRTY-FIFTH CONVENTION 39

13. RELATION OF SIGMA XI CLUBS TO THE NATIONAL ORGANIZATION:

In his annual report to the Convention President Parker called attention to the large number of Sigma Xi clubs, to the fact that they were for the most part active in support of the objects of the Society, and that suggestions had been made from time to time regarding a more intimate relation between the clubs and the national organization. He asked club representatives to present their recommendations to the Convention. The delegates from North Dakota, Utah, Ohio University, Alabama and Texas Technological College made suggestions covering:

- a. privileges of delegates at Conventions;
- b. election of members and associates into clubs;
- c. the influence on their respective institutions of the Society through the medium of the clubs.

President Parker assured the clubs that the Executive Committee would take under sympathetic consideration all the suggestions made.

14. ELECTION OF OFFICERS:

The Committee on Nominations, consisting of

Harlow Shapley, Harvard, Chairman,
C. W. Greene, Missouri,
J. K. Roberts, Virginia,

presented the following recommendations:

- a. For member of the Executive Committee for the term of five years, to succeed Prof. L. J. Cole, whose term of office expires in January 1935, Prof. Dayton C. Miller of the Case Chapter;
- b. For member of the Alumni Committee for the term of five years, to succeed Mr. C. E. Davies, whose term of office expires in January 1935, Mr. C. E. Davies.

It was

Voted—To authorize the Secretary to cast a ballot for the officers as named.

President Parker declared the officers elected as named by the Committee.

15. ANNUAL ASSESSMENT:

(See Executive Committee Minutes, item 13).

It was

Voted—That the recommendations of the Executive Committee regarding assessment and collection be adopted.

16. REPORT OF COMMITTEE ON AWARD OF CERTIFICATES IN COMMENDATION OF RESEARCH:

See page 53 this issue.

17. ADJOURNMENT:

The Convention adjourned at 5.45 P.M.

EDWARD ELLERY.

PRESIDENT'S REPORT FOR 1934

1. NEW CHAPTERS:

During the year two chapters have been added to the organization—M. I. T., installed April 5, with your President and the Secretary as the installing officers, and Tulane, April 13, with the Secretary as the installing officer.

The Society now numbers sixty-four chapters, with a total enrollment of approximately 12,500 members and associates.

There are thirty-two Sigma Xi clubs, many of them very active in promoting the spirit of research in their respective institutions. The time has now come when the national organization must take some action, looking toward a fuller recognition of our clubs and a closer relation of the clubs to the Society at large. There are representatives of clubs at this convention, and it is expected and hoped they will present suggestions on this important subject for the consideration of the convention.

2. PETITIONS FOR CHARTERS FOR CHAPTERS:

The Executive Committee will present to you later in the Convention two formal printed petitions for charters for chapters, with a recommendation for favorable action—one from Smith College, and one from Wesleyan University. Both institutions have been under consideration by the Executive Committee for some time, both have been visited by officially appointed visitors who have made personal survey of the resources, equipment and research in progress, and submitted carefully prepared reports of their findings. As a result of this intimate scrutiny of the existing conditions at the institutions, and of the conviction that the prospects of continued output of worthy research work, the Executive Committee feels confident that the Society will do well to grant these petitions. The Committee is prepared to answer questions about the institutions, if delegates care to ask them, when the petitions come up for action.

3. CERTIFICATES IN COMMENDATION OF RESEARCH:

The Convention will recall that in 1933 Sigma Xi made its first award of certificates in commendation of research to students in institutions where there is no chapter. There were thirty candidates from eleven institutions. Eighteen certificates were awarded to candidates from seven of the colleges and universities.

The task of reading the theses and scrutinizing the scholastic record of the candidates was a considerable one, and required a great deal of time.

At the Spring meeting the Executive Committee voted to limit the number of candidates from any one institution to three students in each of the fields of biology, chemistry and physics.

Fifteen theses were submitted from seven institutions, and ten awards were made to students in five institutions.

The Committee of award was:

Prof. R. A. Gortner

Prof. J. G. Leach

Prof. S. C. Lind

Prof. D. E. Minnich

Prof. L. S. Palmer

Prof. H. Schmitz

Prof. J. T. Tate,

all from the University of Minnesota.

4. INFORMAL PETITIONS AND INQUIRIES ABOUT POSSIBLE CHAPTERS:

The Executive Committee has under consideration informal petitions for charters for chapters from three institutions, and preliminary inquiries from fourteen others. The Committee proceeds slowly and conservatively with this important matter.

5. THE SEMI-CENTENNIAL:

The Special Committee on our Semi-Centennial, which is to be celebrated in Ithaca in June 1936, will present a report of progress later in the Convention. Suggestions and comments will be welcome.

6. THE NATIONAL OFFICERS:

The Society may be assured that the National Officers realize the growing importance and influence of Sigma Xi, and their responsibility as directors of a great work. The officers give generously of their time and thought, and every suggestion about the conduct of the Society's business is very carefully considered. They ask chapters and clubs to communicate their ideas and recommendations freely to the Secretary, who will present them to the Executive Committee at either the Spring or December meeting, or both.

GEORGE HOWARD PARKER, *President*.

REPORT OF THE SECRETARY FOR 1934

1. With the growth in numbers of chapters and members and associates, there is, of course, an increase in the demands on the secretary's office. This is to be expected and desired. The following statistics give you some idea of the mechanical work done in the office:

a. Approximately 12,500 wrappers for the QUARTERLY are addressed four times a year, or a total of 50,000 for the year.

b. Approximately 15,000 envelopes were addressed and mailed to alumni members and associates in connection with the alumni fund for grants-in-aid.

c. The Society disposes of approximately 1,000 emblems during the year, and acknowledgment of the receipt of the order is sent to each purchaser.

d. Chapter and club correspondence, enquiries from various sources about the policies and principles of the Society, communications between the national officers and the secretary, and much miscellaneous business, amount to an average of about 200 letters per month.

e. Hence, the mail business alone of the secretary's office for 1934 amounted to something like 68,400 individual pieces.

2. While on the subject of mechanical work of the office, the secretary reports what is well known to many of you; namely, the human family still retains much of the nomadic character of its ancestors. It is, therefore, not surprising that some 2,000 of our alumni members and associates no longer live where they did in 1932—the year of our last circularization of that body—and failed to tell us to what place they had gone. We expect annual changes in chapter enrollment, and are entirely dependent on chapter secretaries for up-to-date information about their constituency. With something like 27,500 individuals in our files, you can all understand that the services of one clerk of records is scarcely adequate to keep our files 100 percent correct.

3. In connection with the Semi-Centennial, it is proposed to issue a Semi-Centennial Record and History uniform with a similar publication commemorating the first Quarter Century of the Society. Early in 1935 work will be begun to bring up-to-date addresses of, and information about, Sigma Xi members and associates. The aid of chapter secretaries will be solicited in this important undertaking, because it is only through chapters that we can hope to secure correct data about their alumni.

4. But, of course, the mechanics of our office are not the only, or the important, part of the work of the secretary's office. Constant touch with chapter activities is attempted with a view of reporting unusual features for the consideration and benefit of all chapters. Most of the chapters hold periodic meetings during the academic year, varying in number from four to eight. At these meetings, scientific lectures are given, usually by a member of the instruction staff of the institution and on the particular research on which the lecturer is engaged. A good many chapters, at one or more meetings, have lectures by guest speakers. To these meetings, the public is invited and the address is frequently preceded by a dinner, so that the occasion is both social and scientific. Twenty chapters report such events.

A few chapters have reported the award of research prizes in various forms: Colorado, Swarthmore and Virginia. The latter chapter awards three such prizes—one of \$50 for the best paper of the year by a graduate student in biology, one of \$100 for the most noteworthy contribution to science from the members of the faculty and graduate scientific schools, and one of from \$600 to \$1,000 for the best paper dealing with the subject of surgery. A few other chapters have research prizes, but have not reported an award.

Minnesota reports that in accordance with its custom of recent years, a series of four public lectures was given on the topics, "Power," "Production," "Transportation," and "Communication." The total attendance at these lectures was 7,500.

Rochester reports its annual Sigma Xi Day, with a morning lecture for young people on "Back-yard Wonders—The Strange History of some Local Inhabitants," a series of afternoon lecture demonstrations on current scientific research, and the annual public lecture (given in the evening) by Doctor Edwin B. Wilson, of the Harvard School of Public Health, on "Factors in Mental Ability."

5. The issues of the *QUARTERLY* now go to about 12,500 individuals as stated above. During the year, we have been privileged to publish some noteworthy papers—Sigerist, of Johns Hopkins, on "Anatomy," Mees, of Eastman Kodak Company, on "Science and Society," Bush, of Massachusetts Institute of Technology, on "Engineering Research," Faust, of Tulane, on "Human Body and Disease," Whitney, of the General Electric Company, on "Science Hobbies and Habits," Langmuir, of the General Electric Company, on "Science as a Guide in Life," Shepard, of Purdue, on "The Organization of the Family," Stagner, of Wisconsin, on "Research for Profit or Service" and Coker, of North Carolina, on "Methods vs. Problems."

In prospect for the 1935 issues are equally brilliant and varied offerings, on Antarctic Geology, Forestry and the CCC, Old Features of the New Deal, Color Blindness in Japan, Adventures in Industrial Chemistry, Early Aspects of the Scientific Method, Hereditary Factors in Obesity, Instincts in Man, The Future Need for Farmland, and Fundamental Principles in Research Technique.

6. By action of the Thirty-third Convention, the Semi-Centennial of Sigma Xi will be observed in Ithaca, in June, 1936. You will have, at this Convention, a preliminary report of the Semi-Centennial Committee. Chapters and clubs will be asked, early in January, to appoint a representative to serve on a Semi-Centennial-Committee-at-Large, to cooperate with the Central Committee in making this important event a worthy recognition of the accomplishments of science during fifty years, and the brilliant scientific achievements in prospect in the next quarter century.

7. Chapters and clubs are urgently requested to keep in touch with the Executive Committee through the secretary's office. Suggestions and comments about the principles and policies of the organization are always welcomed by the national officers. All recommendations from chapters and clubs will be faithfully presented and given careful and sympathetic consideration at the Spring or December meeting of the officers, or at both. Except under most unusual circumstances, letters from chapters will be personally answered on the day they are received, and actions taken by the Executive Committee will be communicated to those directly concerned immediately following the meetings of that body.

EDWARD ELLERY, *Secretary.*

REPORT OF THE TREASURER

The 1934 assessments of all chapters, except the University of Illinois and the University of Wisconsin, were paid within the year. (The Wisconsin Chapter paid just after the end of the fiscal year.)

RECEIPTS

Cash on hand, January 1, 1934.....	\$ 5,987.88
Chapter assessments for 1934.....	6,230.50
Chapter assessments for 1933, arrears.....	73.25
Overpayment refunded.....	5.00
Initiation fees for 1934.....	2,225.00
Initiation fees for 1933, arrears.....	217.00
Installation fees.....	150.00
QUARTERLY	1.00
Interest on investments.....	979.97
Sale of 2 Public Service Elec. & Gas Co. 4% bonds.....	2,007.53
Sale of Amer. Tel. & Tel. Co. 5½% bond.....	1,117.67
Sale of Amer. Tel. & Tel. Co. 5% bond.....	1,099.46
Sale of U. S. Treasury 4¼% bond.....	1,141.00
Sale of New York Telephone Co. 4¼% bond.....	1,091.98
Sale of New York City bond.....	200.00
Sale of insignia.....	903.00
Refund	69.56
	\$23,499.80

DISBURSEMENTS

Secretary's office (total—\$4,785.03) :	
Assistants	\$ 2,485.60
Office, supplies, stamps, etc.	499.43
Secretary's stipend.....	1,800.00
Treasurer's office (total—\$179.67) :	
Assistant	150.00
Auditing 1933 books.....	10.00
Postage, etc.....	19.67
Officers' travelling expenses.....	867.66
QUARTERLY (4 issues).....	1,514.52
Engrossing charters.....	82.20
6 U. S. Treasury 2½% bonds.....	6,116.25
10 New York City bonds.....	1,985.00
3 U. S. Treasury 3% bonds.....	3,102.09
Accrued interest on above bonds.....	25.46
Alumni Secretary office.....	63.50
Refund to chapter.....	5.00
Overpayment	69.56
Check tax.....	1.82
Cash on hand, December 31, 1934.....	4,702.04
	\$23,499.80

REPORT OF THE TREASURER

45

INVESTMENT ACCOUNT—GENERAL

The current market value of most of these bonds is much below the purchase price as listed below, particularly for the railroad bonds. All the companies continue to pay interest on their bonds except the St. Louis and San Francisco Railway, which is in receivership.

\$1,000 Amer. Tel. & Tel. 5½% bond at.....	\$ 991.94
\$1,000 Consolidated Gas of New York 5½% bond at.....	1,002.90
\$1,000 St. Louis & San Francisco Railway 4% bond (certificate of deposit) at.....	796.35
\$1,000 Baltimore & Ohio Railway 5% bond at.....	955.00
\$1,000 Pacific Gas & Electric Co. 5½% bond at.....	1,045.00
\$1,000 Philadelphia Co. 5% bond at.....	979.50
\$1,000 Erie Railroad Co. 5% bond at.....	947.00
\$1,000 Southern Railway Co. 6% bond at.....	1,152.00
\$1,000 Western Electric Co. 5% bond at.....	1,029.50
\$1,000 Philadelphia Company 5% bond at.....	997.00
\$1,000 New York Central 6% bond at.....	1,032.00
\$1,000 Canadian Pacific 5% bond at.....	1,010.00
\$1,000 U. S. Treasury 4% bond at.....	999.06
\$1,000 U. S. Treasury 3% bond at.....	942.50
\$1,000 U. S. Treasury 3% bond at.....	942.50
\$1,000 U. S. Treasury 3% bond at.....	942.50
\$1,000 U. S. Treasury 2½% bond at.....	1,019.37½
\$1,000 U. S. Treasury 2½% bond at.....	1,019.37½
\$1,000 U. S. Treasury 2½% bond at.....	1,019.37½
\$1,000 U. S. Treasury 2½% bond at.....	1,019.37½
\$1,000 U. S. Treasury 2½% bond at.....	1,019.37½
\$1,000 U. S. Treasury 2½% bond at.....	1,019.37½
\$200 New York City bond at.....	198.50
\$200 New York City bond at.....	198.50
\$200 New York City bond at.....	198.50
\$200 New York City bond at.....	198.50
\$200 New York City bond at.....	198.50
\$200 New York City bond at.....	198.50
\$200 New York City bond at.....	198.50
\$200 New York City bond at.....	198.50
\$1,000 U. S. Treasury 3% bond at.....	1,034.03
\$1,000 U. S. Treasury 3% bond at.....	1,034.03
\$1,000 U. S. Treasury 3% bond at.....	1,034.03
<hr/>	
	\$26,768.09

ALUMNI FUND

RECEIPTS

Cash on hand, January 1, 1934.....	\$ 0,000.00
Receipts from subscriptions.....	1,507.95
Interest on investments.....	90.00
<hr/>	
	\$ 1,597.95

DISBURSEMENTS

Research:

Charles E. Braun.....	\$ 150.00
Fred W. Emerson.....	60.00
T. L. Smith.....	150.00
E. T. Hodge.....	100.00
H. R. de Silva.....	100.00
R. E. Hoffstadt.....	100.00
I. M. Kolthoff.....	300.00
F. C. Schmidt.....	100.00
W. J. Luyten.....	200.00
	<hr/> \$ 1,260.00
Cash on hand, December 31, 1934.....	337.95
	<hr/> \$ 1,597.95

INVESTMENT ACCOUNT—ALUMNI FUND
(Securities carried at cost)

\$1,000 Southern Pacific Co. 4½% bond at.....	\$ 905.75
\$1,000 Southern Pacific Co. 4½% bond at.....	907.00
	<hr/> \$ 1,812.75

GEORGE B. PEGRAM, *Treasurer.*

December 31, 1934.

We have audited the accounts of the Treasurer of the Society of Sigma Xi for the year ending December 31, 1934, and certify that the income shown by the books of the Treasurer has been duly accounted for, that payments have been properly vouched and that the balance sheet and accounts submitted contain a true statement of the financial condition of the Society. We have also examined the securities in the hands of the Treasurer and find the following bonds: \$1,000 Amer. Tel. & Tel.; \$1,000 Consolidated Gas of New York; \$1,000 St. Louis & San Francisco Railway (certificate of deposit); \$1,000 Baltimore & Ohio Railway; \$1,000 Pacific Gas & Electric; \$1,000 Philadelphia Co.; \$1,000 Erie Railroad; \$1,000 Southern Railway; \$1,000 Western Electric; \$1,000 Philadelphia Co.; \$1,000 New York Central; \$1,000 Canadian Pacific; \$1,000 U. S. Treasury; \$1,000 U. S. Treasury; \$1,000 U. S. Treasury; \$1,000 U. S. Treasury; \$1,000 U. S. Treasury; \$1,000 U. S. Treasury; \$1,000 U. S. Treasury; \$1,000 U. S. Treasury; \$1,000 U. S. Treasury; \$1,000 U. S. Treasury; \$200 New York City; \$200 New York City; \$200 New York City; \$200 New York City; \$200 New York City; \$200 New York City; \$200 New York City; \$200 New York City; \$200 New York City; \$200 New York City; \$1,000 U. S. Treasury; \$1,000 U. S. Treasury; \$1,000 U. S. Treasury; \$1,000 Southern Pacific; \$1,000 Southern Pacific.

L. BRETT,
J. T. FINNERAN,
Auditors.

THE NEW OFFICERS

DAYTON CLARENCE MILLER

Doctor Miller has been associated with the Case School of Applied Science since 1890, as instructor, assistant professor and professor of physics. He began his career as a teacher of science in 1888 at his Alma Mater, Baldwin University, Berea, Ohio, and from that time he has become increasingly prominent in science circles in this country and abroad both in teaching and in research. He is a leading investigator of the ether drift and a well known authority in that branch of physics which deals with the phenomena of sound. Doctor Miller has made and recorded an enormous number of ether-drift observations from which the conclusion is drawn that there is a constant relative motion of the earth and the ether. His experiments in sound have resulted in the determination of the physical characteristics of the tone quality of various orchestral instruments, and have given quantitative analysis of vowel tones and a scientific classification of vowels. Doctor Miller has investigated auditorium acoustics and has specified the acoustics design and treatment for a number of public auditoriums in the United States.

Doctor Miller's work has been recognized and he has been honored by many universities and civic and scientific organizations throughout the country. Dartmouth College, Miami University, Western Reserve University, and his alma mater have decorated him with honorary degrees; Franklin Institute and the American Association for the Advancement of Science have accorded him recognition for his brilliant research work; and the City of Cleveland has conferred upon him a medal for distinguished public service.

Doctor Miller was elected to membership in Sigma Xi the Case Chapter in 1904.

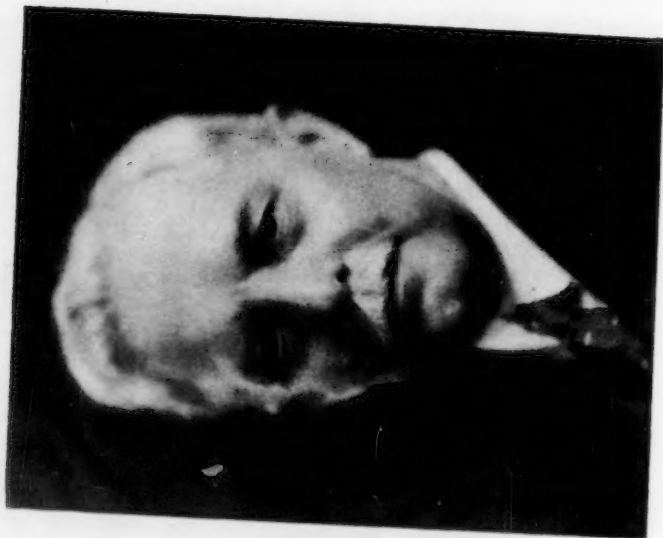
C. E. DAVIES

Mr. Davies has been identified with the alumni movement of Sigma Xi since its inception in 1922. Much of the work accomplished in that part of the Society's activities originated with him and has had his enthusiastic and constant support. He was elected to membership in Sigma Xi by the Rensselaer Chapter in 1914, and for the past dozen years has become intimately acquainted with the organization and its ever expanding importance and influence in the promotion of research.

A graduate of the Rensselaer Polytechnic Institute, Mr. Davies began his technical career with the Smith Premier branch of the Remington Typewriter Company. His connection with that organization was interrupted by the World War, when he served as first lieutenant and later as captain in the Ordnance Department of the U. S. Army. He is responsible for developing



C. E. DAVIES



DAYTON CLARENCE MILLER

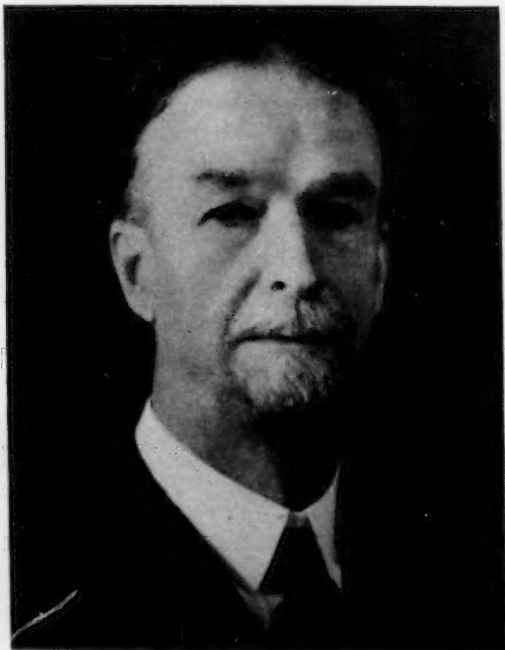
methods of manufacture and production control schemes for the manufacture of artillery ammunition, and for the operation of the fuse shop at the Frankford Arsenal.

Mr. Davies left the typewriter company in 1920 and began his work with the American Society of Mechanical Engineers, which he has served as associate editor, and assistant secretary, as executive secretary, and now as national secretary, succeeding Dr. Calvin W. Rice who died in October, 1934 after twenty-seven years of active service in that important engineering organization.

Mr. Davies interests and activities are many. He serves the Newcomen Society (England) for the study of the History of Engineers as honorary corresponding secretary for North America. He was the first secretary of the Engineers' Council for Professional Development, a conference of engineering, educational and licensing bodies that is concerned with the guidance, selection and education of engineering students, the accrediting of engineering school curricula, and of engineering after graduation from college, and certification as members of professional engineering societies and as professional engineers. He is treasurer of the Gantt Medal Board of Award, chairman of the District Scholarship Committee of Pi Kappa Phi, and member of the Council of the Society of Promotion of Engineering Education.

PRINCETON CHAPTER OF SIGMA XI MINUTE ON THE DEATH OF DR. THEOBALD SMITH

In the death of Dr. Theobald Smith on December 10, 1934, the Princeton Chapter of Sigma Xi has lost one of its most distinguished members. He was a charter member of this Chapter and one of the early members of the founders' Chapter at Cornell University.



DR. THEOBALD SMITH

Doctor Smith was born at Albany, N. Y., on July 31, 1859. He was graduated from Cornell University in 1881 where his associations with Professors Gage and Wilder gave him a life-long interest in general biological problems. He received the degree of M.D. from the Albany Medical School in 1883, and from 1884 to 1895 he was assistant, and then chief of the Division of Animal Pathology, Bureau of Animal Industry, Washington, D. C. From 1886 to 1895 he was lecturer and then professor of bacteriology in Columbian, now George Washington University, and from 1895 to 1914 was professor of comparative pathology in Harvard University. In 1911-1912 he was exchange

professor from Harvard University to the University of Berlin. He was also director of the Antitoxine and Vaccine Laboratory and pathologist of the State Board of Health of Massachusetts from 1895 to 1914.

He was a member of the Board of Trustees of the Carnegie Institution of Washington and a scientific director of the Rockefeller Institute for Medical Research from its beginning in 1901, acting as vice-president of the Board from 1924 to 1933 and succeeding the late Dr. William H. Welch as president in October, 1933. He came to Princeton in 1915 to organize the Department of Animal Pathology of the Rockefeller Institute and served as its director until his retirement in 1929.

Doctor Smith's researches on parasitism and disease were very extensive and of the most far-reaching importance; only a few of these can be mentioned here. With Doctor Salmon he demonstrated for the first time that killed cultures of bacteria may produce immunity; this is the principle now used in protective vaccination against typhoid, paratyphoid and cholera. While in the Bureau of Animal Industry in Washington he demonstrated between 1888 and 1893 that ticks were the means of transmission of Texas cattle fever. This was the first proof ever given that insects may transmit germs of disease and it opened the way to the discovery by others of the method of transmission of malaria, yellow fever; African sleeping sickness, etc. In 1896-1898 he proved that the bovine type of tubercle bacillus differed from the human type and this has played an important part in the present campaign against tuberculosis. He first observed in 1904 cases of serum sickness and death in guinea pigs that had received a second injection of horse serum, and this hypersensitivity, which is akin to certain forms of asthma, hay fever, etc. in man, was at first known as the "Theobald Smith phenomenon." He demonstrated in guinea pigs the immunizing action of balanced or neutral mixtures of diphtheria toxine-antitoxine, and this method is now in general use as a preventive of human diphtheria. In addition to these and other discoveries bearing directly upon the causes and control of human diseases, Doctor Smith made many other studies on diseases peculiar to domestic animals, which for lack of time cannot be enumerated here. Fortunately he had published only a few months before his death his Vanuxem Lectures for 1933 on "Parasitism and Disease," in which volume he summarized much of this work, and in which he emphasized especially the biological interrelationships of parasite and host. Indeed it may be said that it was his broad biological outlook and especially his confidence in the principle of organic adaptation between parasite and host that guided him in all his studies.

His really epoch-making discoveries brought him world-wide recognition and honors. He was a member of more than a score of the leading scientific societies of America and Europe, including the National Academy of Sciences of the United States, the Royal Society of London, the Royal Academy of Denmark, the Academy of Science of Paris, etc. He had been awarded by universities and scientific societies in this country and abroad eleven medals and twelve honorary degrees.

Although he was one of the most illustrious members of this Society he was so modest, so simple in manner, so sincere in word and deed and so kind a friend, that our admiration for his achievements was ever mingled with affection for the man. The Princeton Chapter of Sigma Xi places on record its sorrow in the loss by death of its most distinguished member and its confidence that his influence and work are immortal.

E. G. CONKLIN, *Chairman,*

CARL TENBROECK,

H. N. RUSSELL, *President,*
Princeton Chapter.

N. H. FURMAN, *Secretary,*
Princeton Chapter.

Committee.

REPORT OF COMMITTEE OF AWARD OF CERTIFICATES IN COMMENDATION OF RESEARCH

The Committee on certificate awards from Sigma Xi submits the following report. The theses were passed out to individual members of the Committee who read and returned them with their written opinion. Awards were made as follows:

Joseph Meyers Ashcraft, West Virginia University; "European Canker of Black Walnut and other Trees."

Benson Glenn Brand, West Virginia University, "Some Physical Constants of the Mono Alkyl Ethers of Ethylene Glycol and Diethylene Glycol."

William Carson Brown, West Virginia University; "A Study of the Causes of Oxidized Flavor in Milk."

John D. Erit, University of Vermont; "The Preparation of Some New Carbocyclic Diguanidines of Possible Physiological Significance."

Majel Margaret MacMasters, Massachusetts State College; "Investigations concerning some factors influencing Rhythmic Crystallization from Aqueous Solution."

Nora M. Mohler, Smith College; "A Spectrophotometric Study of Smoky Quartz."

Henry E. Paul, Oklahoma A. and M. College, "Calcium Distribution in Chicken Blood."

Winifred M. Randall, University of Vermont; "The Preparation of a Series of Guanidine Derivatives of Possible Physiological Significance."

Bryan C. Redmon, Massachusetts State College; "Effect of Cranberries on Urinary Acidity and Blood Alkali Reserve."

Audrey Howard Van Landingham, West Virginia University; "The Effect of Low Calcium and Low Phosphorus Rations on Dairy Heifers."

R. A. Gortner, Chief of the Division of Agricultural Biochemistry;

J. G. Leach, Associate Professor of Plant Pathology;

S. C. Lind, Director of the School of Chemistry;

D. E. Minnich, Chairman of the Department of Zoology, Chairman of Committee of Award;

L. S. Palmer, Professor of Agricultural Biochemistry;

H. Schmitz, Chief of the Division of Forestry;

J. T. Tate, Professor of Physics;

(all from the University of Minnesota.)

CHAPTER OFFICERS

List Furnished by the Secretaries of the Chapters

CHAPTER	PRESIDENT	VICE-PRESIDENT	SECRETARY	TREASURER
Cornell	H. H. Whetzel	A. R. Mann	G. E. Grantham	A. J. H.
Rensselaer	A. W. Bray	I. L. Rosenholtz	F. M. Sebast	H. E. S.
Union	F. W. Grover	E. E. Dale	F. J. Studer	F. J. S.
Kansas	U. G. Mitchell	R. Taft	E. L. Trece	H. E. J.
Yale	B. F. Dodge	W. J. Wohlenberg	L. S. Stone	H. H. W.
Minnesota	S. C. Lind	F. K. Butters	H. E. Hartig	G. A. G.
Nebraska	D. A. Worcester	W. A. Willard	E. N. Andersen	M. G. B.
Ohio State	F. C. Caldwell	C. S. Smith	F. A. Hitchcock	P. A. B.
Pennsylvania	H. C. Bazett	C. P. Olivier	E. P. Helwig	W. R. B.
Brown	H. C. Bumpus	A. M. Banta	P. H. Mitchell	W. A. B.
Iowa	P. C. Jeans	A. Ellett	F. T. Mavis	P. H. B.
Stanford	R. E. Swain	C. V. Taylor	P. H. Kirkpatrick	P. H. B.
California	R. E. Clausen	V. F. Lenzen	G. E. Troxell	A. C. B.
Columbia	M. T. Bogert	H. W. Webb	A. W. Thomas	A. W. B.
Chicago	F. C. Koch	C. R. Moore	C. G. Croness	C. G. B.
Michigan	E. H. Kraus	C. V. Weller	L. S. Ramsdell	A. A. C.
Illinois	F. E. Richart	H. H. Mitchell	A. R. Cahn	T. S. B.
Case	C. F. Prutton	P. E. Hemke	C. W. Wallace	W. M. B.
Indiana	P. M. Harmon	C. E. May	C. M. Louttit	T. M. B.
Missouri	C. W. Greene	A. E. Stearne	F. F. McKenzie	Dorothy
Colorado	C. F. Poe	W. B. Draper	H. B. Van Valken-	burgh
Northwestern	O. J. Lee	E. D. Crabb	F. T. Gucker	Elizabeth
Syracuse	E. T. Apfel	R. R. Hirt	J. M. Robeson	W. R. B.
Wisconsin	H. W. March	E. G. Hastings	C. A. Richards	W. E. B.
Univ. of Wash.	M. H. Hatch	R. H. Gundlach	A. V. Eastman	F. J. C.
Worcester	F. R. Butler	C. F. Meyer	W. E. Lawton	H. W. B.
Purdue	C. F. Harding	E. C. Young	L. E. Klemme	R. F. B.
Washington Univ.	L. F. Thomas	E. Siroky	C. E. Stout	Mildred
Dist. of Columbia	A. Wetmore	Wm. Bowie	Miss Vinnie Pease	Wm. L.
Texas	M. Y. Colby	H. R. Henze	R. H. Cuyler	C. P. B.
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EDWARD ELLERY,
National Secretary, Sigma Xi,
Union College,
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